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VIEWS, NEWS AND INTERVIEWS.

An overhead trolley railway will be built between Mons and Bossu in Belgium. The road is expected to cost $125,450, of which $46,320 will be spent for rolling stock. The builder must operate the line for a fixed sum during two years under the government's control. The entire work must be complete within 25 weeks after the award of the contract, and the line must be open not later than February, 1899. The road will have a total length of 6.67 miles, not including the branch lines. It is specified that all the material for the construction of the road must be manufactured in Belgium.

The eighth annual exhibition of the Winnipeg Industrial Exposition Association will be held in Winnipeg, Man., from July 11 to 16. It is said that a number of American manufacturers will present exhibits, and that a large attendance is expected.

Chester E. Chesrow has just returned to Sharon, Pa., from Spain, where he was sent in the interest of the Westinghouse Electric and Manufacturing Company, of Pittsburgh. He is reported as saying that in government circles the more conservative officials think the war won by the United States, but are afraid to make public this fact for fear of the civil strife. The Spanish are very bitter toward the Americans. Wherever the word America appears on any of the public buildings or hotels the government has issued orders to have it erased.

The death of Albert P. Massey at sea while on his way to London was announced by a cable dispatch last week. Mr. Massey was mechanical engineer for the New York Air Brake Company. He leaves a widow and four children, one of whom is Ensign George B. Massey, recently appointed an electrical engineer with the Rhode Island Naval Militia at Newport, R. I.

Carl Hartmann, a resident of Newark, N. J., and an electrician, has been recruiting a company, made up of electricians and telegraphers, which, when completed, he intends to offer to the government as a reinforcement to the Signal Corps. Hartmann has 100 men enrolled and ready to enlist.

The Brooklyn Heights Railroad Company, of Brooklyn, N. Y., has made arrangements to operate its trolley parlor cars on the Sea Beach route to Coney Island each Sunday during the season. The cars will start from the City Hall in Brooklyn and will run hourly, beginning at 1 P. M. An upholstered armchair will be provided for each passenger and the fair each way will be 25 cents.

An X-ray plant was shipped to San Francisco last week, to be sent from there to Manila. It is for the use of the surgeons of our army in the Philippines. Army surgeons have been experimenting with X-ray apparatus for the past few months. These experiments have shown that about 30 per cent of the operations that would have to be made ordinarily can be avoided by the use of the X-ray plant. Other plants have been sent to Tampa, and two or three are now supposed to be on their way with our troops to Cuba.

The field telegraph train of the regular army has arrived at Tampa, Fla. The train is used only in time of war, when battles are being fought and opposing armies are not many miles separated. There are four sections of the train, each of which carries equipment and material sufficient to lay a telegraph wire 15 miles. With the entire train a complete telegraph line can be laid a distance of 60 miles in short time. The field train was formerly at Fort Sam Houston, Tex.

The Milwaukee, Wis., Electric Railway Company has won its four-cent fare case. The United States Court decided that the city ordinance providing for four-cent fares was invalid.

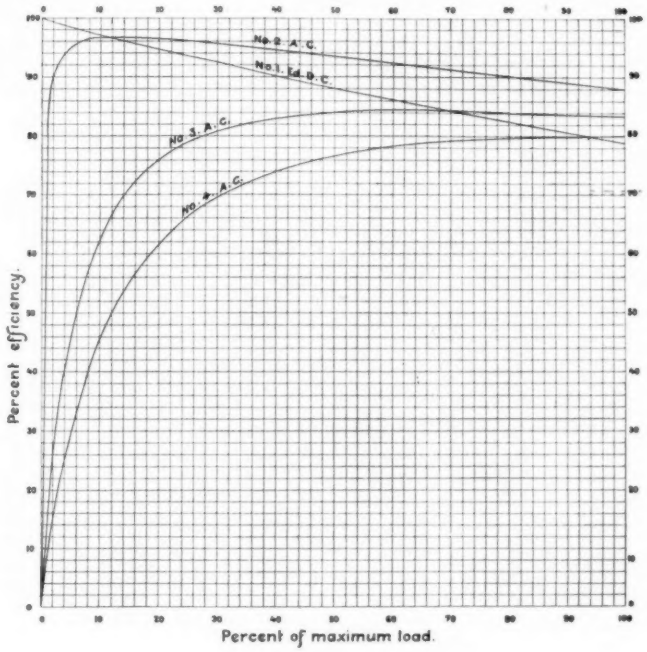

FIG. 1. CURVES OF DISTRIBUTION EFFICIENCY.

DIAGRAM ILLUSTRATING MR. WAGNER'S PAPER ON "GENERAL DISTRIBUTION FROM CENTRAL STATIONS BY ALTERNATING CURRENTS."

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Conclusion of Papers on Alternating and Direct-Current Station Practice.

TWO ABLE PAPERS, REPRESENTING OPPOSITE SIDES, READ BY MESSRS. WAGNER, OF ST. LOUIS, AND FERGUSON, OF CHICAGO—OPINIONS APPARENT THAT BOTH ALTERNATING AND DIRECT CURRENTS COULD BE USED TO ADVANTAGE IN THE SAME STATION.

The following is the conclusion of Mr. Wagner's valuable paper on "General Distribution from Central Stations by Alternating Currents," continued from page 396 of the ELECTRICAL REVIEW for June 15:

A few more enlightened experts—plants were always installed by experts in the early days—eventually conceived the novel idea that if the drop, a little of which they had discovered by that time, could be confined to a greater extent to those portions of the lines where there were no lights, some might be spared from the lighting districts. A few feeder lines were therefore stuck in here and there to boost up the pressure where it was lowest.

The regulation was all effected by means of the dynamo field rheostat, and the pressure indicated by a voltmeter on the secondary of a transformer whose primary was connected to the bus bars on the switchboard. A few lamps were also often operated by the same transformer to light the switchboard or other parts of the station. The station attendant was, of course, in absolute ignorance of the pressure at any point on the lines where lamps were used. The pressure was therefore usually run high enough to be on the safe side. The attendant was sometimes instructed to let his voltmeter needle follow gently the maneuvers of his ammeter, as there was thought to be a more or less intimate connection between volts and amperes and the volts ought not to be allowed to get too far behind.

If any one ever breathed a suggestion of pressure wires, it was probably his last breath. At any rate, he was never heard of again. What! pressure wires with alternating current? Preposterous idea. Alternating and progression were considered almost

synonymous terms. Antiquated ideas must be abandoned.

This faintly-whispered need might, however, be heard again, so, to meet the emergency, a compensating voltmeter was produced that could be adjusted for any drop in the lines. It was ingeniously arranged so that a small series transformer in the main line would send currents opposing those operating the voltmeter, thereby making the needle or index drop back approximately proportionately to the current in the line. This device was a great help, and caused the drop in lines to jump into prominence at once. It would be quite perfect if the drop in alternating-current lines were proportional to the current, but it is not. The power factor of ordinary alternating-current systems is usually quite low at light loads, and, except with very small wire, an ampere may therefore produce much more drop proportionately at light load than at heavy load.

One alternating current station of which I have intimate knowledge has used pressure wires in connection with each feeder for years. There may be a few others, but they are rare exceptions even to day.

The usual system of distribution provides a separate transformer for each customer. In many cases this implies the use of a very small transformer. It is impossible to make the efficiency of small transformers high. As each customer may at times use all of his lamps, he must have full transformer capacity for such an emergency. The ordinary ratio between maximum station loads and the number of lamps connected is in most cases under 50 per cent where meters are employed. The transformers then being of a total capacity equal to the number of lamps connected, average at best only 50 per cent of their rated capacity at the maximum station load. In most stations the average load generated is much less than 25 per cent of the maximum load, and, therefore, with twice the transformer capacity of that represented by maximum station load, the average transformer load would not exceed 10 per cent of the transformer capacity all the year round.

The efficiency of the average modern transformer of usual size at 10 per cent of its rated load is not over 65 per cent, and the average of transformers at present in use not more than 50 per cent. It is perfectly safe to say that there is not an alternating-current station to-day using individual transformers for each or neighboring customers that can show an average efficiency of distribution of over 60 per cent, and few that can show over 50 per cent.

In Europe it is, to some extent, the practice to use transformer substations with low-potential distribution from these points. Transformers are cut in and out at these substations by attendants according to the demand for current. It is doubtful if, after paying interest on the investment in property and housing for these transformer stations, together with the investment in instruments and switches required, and the attendants' wages, there is very much saving effected. Had we nothing better to turn to than these systems, the cost of distribution from large stations would be extreme compared with the direct-current, Edison three-wire system, and competition with the latter could not be a success.

Another very important consideration is the economy or efficiency of lamps used. To employ successfully the highest economy lamp made, a very uniform pressure must be maintained. With the usual alternating-current system, and with an equally good disposition of feeders and mains, the variations of pressure will exceed those in a direct-current system by nearly three per cent, on account of the transformer drop, and to secure even this limit of variation pressure wires must be used with each feeder.

It is not surprising to find, therefore, that almost all alternating-current stations are using lamps requiring 20 per cent more current than those used by direct-current stations.

I can not refrain from remarking here that to operate any station, alternating or direct current, without pressure wires, is to be worse than penny wise and pound foolish. In any alternating-current station employing overhead wires, the saving in lamp renewals would equal the cost of pressure wires in little over a month's time. I might also add that the total loss of lamps is not the most serious result of variations in pressure. Such variations cause a rapid decline in candle-power, and low candle-power means disaffection of customers and the increased use of gas.

Now, let us leave for the time the alternating-current station and its usual system of distribution, and adjourn to a modern Edison station, to see if there can really be anything learned from so antiquated a source. On entering, we see at first large direct-connected generators running in multiple. We have also seen those in a few alternating-current stations, and perhaps of larger size. We next see a very compact and convenient switchboard. Neither is that altogether new. But let us ask to see the system of distribution; for that is what we most want to look into.

On the plans of this system of distribution a remarkable network of feeders and mains is laid before us, most carefully calculated for the maintenance of uniform pressure. Means for regulating more or less independently the pressure on each feeder are provided. From numerous points in the system, corresponding to the feeder terminals, pressure wires are brought to the station, and indicators show the pressure at all these points. Numerous devices and appliances are shown us which must have been the result of years of experience in the development of distribution methods. We look with admiration, and ask why, with this apparently far more perfect system in existence, have we been working so long to try to perfect a new system that can not to-day, we are informed, produce such results. Why, indeed!

But let us look a little further. What are those massive beams? They do not seem to support anything. "Those are not beams. They are copper wires to carry the current out," we are told. "Wires? Why, they weigh tons!" "So they do, but they are necessary with this system." A very serious drawback, it would seem. Another question troubles us. Why do you occupy ground in a part of the city where property must be very valuable? Why do you not go off to one side where land is cheap? "Oh, we are forced to be near our center of business. If we were twice as far away, we should have to use four times the amount of copper in those bars." This, indeed, seems a very great defect. But are there no other defects in your system? In answer, we are told that there are no others that are considered serious.

If this necessity for using such an enormous amount of copper is the weak point of a beautifully developed system, why do we not endeavor to overcome that particular point and adopt the rest, instead of starting out anew and alone to develop another system from beginning to end? This is the question that should have been considered years ago. Why did we not start where others left off, engraft our alternating current and draw energy and strength from the old roots, instead of trying to grow from the seed to find ourselves running to limbs and branches with very little trunk to speak of. We have tried to overreach our older brother, and now lack his sturdiness and stability.

It is not too late, however, to begin afresh. We are satisfied that at the present time the Edison three-wire system of distribution is the most efficient in use and the most nearly perfect in details We know that the usual system employed with alternating current is not efficient, and does not admit of as close regulation, but it is vastly cheaper to install.

We have thus eliminated the two features in which the ordinary alternating-current system of distribution has been inferior to the direct-current, and have provided means for obtaining better regulation and higher efficiency at a very much less cost of installation than with the direct-current system.

This system was conceived several years ago, and it has since been my good fortune to have an opportunity to install a system of this kind on a large scale, which is now in very satisfactory operation. It is laid out exactly as a three-wire Edison system would be, except that there are no sub-feeders. A network of mains is planned as if for use with direct current. The feeders are all designed for 110-kilowatt maximum load at 1,100 volts, and at each feeder end is placed a 110-kilowatt transformer, feeding into the three-wire network in the same manner and at the same points as with the direct-current system. The transformers are located in manholes of suitable design. From the secondary terminals of each transformer, pressure wires are run back to the station. Each feeder has an independent regulator by which the pressure can be raised or lowered. There are no primary mains, nor any connection whatever between the primary feeders. The regulators perform two functions. They are used to maintain the proper pressure as indicated by the voltmeters and also to divide the load between transformers in any way desired as indicated by the feeder ammeters. It is possible to shift the entire load from one transformer and feeder to an adjacent transformer in this way without sensibly affecting the pressure on the system, and an equal division of load between transformers can be readily maintained at all times if desired. This is a very important consideration when very heavy loads or overloads are to be carried. The distribution of load on any large system is constantly changing as new customers are connected, and in large Edison stations certain feeders often become so overloaded that it is found necessary for their safety to put resistance in series with them to force some of the current to other feeders. The possibility of overloading any individual feeder beyond its share is absolutely provided against in the system described. To make the arrangement of this system perfectly clear, it is illustrated diagrammatically in Fig. 2.

In Fig. 1 are shown four curves of station distribution efficiency. No. 1 is that of a representative Edison three wire, direct-current station. No. 2 is the new alternating-current system described. No. 3 is the usual alternating-current system employing separate transformers for each customer or for adjacent customers, the best modern transformers being used. No. 4 shows the same system, but with the average transformers found on the lines of most existing stations. These curves were plotted from the following data obtained from actual practice:

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent
Feeder loss ...	24	8	10	10
Main loss.....	2	2	2	2
House wiring loss....	1	1	1	1
Transformer loss, iron....	..	.23	6	12
Transformer loss, copper.	..	2.7	1	.5
Total loss at maximum station load.	27	13.93	20	25.5
Efficiency at maximum station load.	78.7	87.9	83.3	79 6

The efficiencies of distribution at assumed average loads are shown to be as follows:

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Load, 25.....	94.1	95.8	78.4	66.6
Load, 20	94 8	96 2	75.3	61.4
Load, 15.....	96.1	96.5	70.3	54 3
Load, 10.....	97.3	96.4	61.9	45.1

At maximum load it will be noticed that the efficiency of alternating current No. 2 is 10 per cent higher than No. 1, the direct current. This means that the same energy can be delivered with 10 per cent less capacity in generators, engines and boilers, or a difference of 10 per cent in the first cost of generating plant. It is pertinent to remark here that alternating-current generators also

(Continued on page 404.)

NORTHWESTERN ELECTRICAL ASSOCIATION.

CONCLUSION OF THE MIDSUMMER MEETING OF THIS ASSOCIATION ON THE STEAMER "NORTHWEST" AND AT DULUTH.

The proceedings and incidents of the excursion of the Northwestern Electrical Association, inclusive of the afternoon of June 13, were presented in the ELECTRICAL REVIEW last week. After a substantial luncheon, tendered by Captain Decker, of the Calumet & Hecla mines, the party again boarded the steamer and started for Duluth.

At 9 P. M. President Copeland called the meeting to order and a paper on "Mechanical Draft," prepared by Mr. Walter B Snow, of Boston, was read by Mr. Cross, in the absence of the writer. The paper was discussed by Messrs. Doherty, Dow, Cross and others. Mr. Dow, of Midland, Mich., then read a paper on "Purification of Water." Mr. A. J. Wurts, of the Westinghouse company, of Pittsburgh, spoke at some length on the subject of "Lightning Arresters," illustrating his interesting remarks on the blackboard.

Mr. Wilson Howell, of Harrison, N. J., Mr. H. M. Swetland, of New York city, and a number of others, joined the party at points along the route after the "Northwest" left Chicago. Mr. F. E. Barker, the gas commissioner of Boston, spoke as follows at the previous meeting on the subject of "The Mutual Relations of Municipalities and Companies." Mr. Barker said:

It is hardly possible to discuss or attempt to discuss a subject of so great practical importance off hand or in any such time as is at my command. The questions involved, when rightly solved, will bring mutual benefits to the companies and the public. Recently, for instance, I had called to my attention the great difference between the prices for gas in Great Britain and in this country, and was asked my opinion as to the reasons why gas should be so much cheaper there than here. I was obliged to say that, after some study of the conditions existing upon the other side of the water, I believed that the attitude of the government toward the companies had been the most important single factor in securing the low prices there prevailing.

The government, whether state or municipal, is just as strongly bound to perform certain duties toward the companies as the companies are to render certain other duties to the municipality or the public. It is not easy, of course, for me now to enumerate or classify these, but a somewhat comprehensive statement about them may be this: That a municipality owes it as a duty to the company performing a public service within its limits to render it every necessary facility for conducting its business so as to acquire a reasonable profit. The authorities may very well afford to do this, can, in fact, hardly afford to do otherwise. Such a course is advisable because it justifies a demand for superior service by the companies. I have had brought within my own observation cases where, under a more intelligent and liberal treatment, companies would have been not only able but willing to favorably respond to more stringent demands, both as to price and quality of service. A company's ability to satisfactorily serve the public is generally proportional to the degree of prosperity which it enjoys. The kind of service which comes from an impoverished concern, to whose embarrassment misdirected official effort may have contributed, is frequently well nigh a public misfortune.

The principles which control in a proper way the relations of municipalities and public service corporations are not essentially different from those which govern in other business relations. Human nature is very much the same in corporations as in individuals, even though you may believe that the former have no souls.

The serious objection to liberal treatment by the public, I regret to say, sometimes appears on account of the unfortunate course of a manager who narrowly and unwisely assumes that because the public gives him certain advantages they are therefore all his, and that he is under no obligation to share any of them with the public. I am glad to believe, however, that the conviction is growing among managers of public service corporations that the prosperity of the interests intrusted to their charge is largely proportional to the excellence of the service which they render and to the liberality with which they treat the public. I suspect that if you were to present some of the foregoing propositions to the municipal officers with whom you may have the most serious and stubborn differences you might be surprised to hear him claim that he was governed by them entirely. I am disposed to believe that responsible municipal officers generally believe in them, but such officials are oftentimes seriously handicapped by their inability to procure the reliable data necessary to the most intelligent action.

In the State of Massachusetts we have done much to aid in this direction by the publication of carefully prepared data concerning all the gas and electric lighting companies within our borders, so that municipal authorities have for their assistance a wide range of facts upon which they may rely with confidence to assist them in their dealings with the companies. I believe that much might be gained by a similar exhibit of data in other states, but I realize that the companies can hardly be in fairness required to exhibit this unless they can have some assurance that it will be made the basis for the adoption of a reasonable and judicious policy on the part of those who exercise the civil authority. another illustration of the fact that the obligations of the companies and the public go hand in hand, and that when both are properly appreciated an administration which is most fair and mutually the most beneficial will result.

I have heard some surprise expressed that where governmental supervision and control was carried to such an extent as it is with us in Massachusetts that there should be so many municipal plants. The fact is that most of them have been built where private capital saw no inducement to go, where, in other words, there had been no private company in existence and the municipality was obliged to undertake the supply or go without it. There are two or three cases which can not be described in this way. In one, I have reason to believe, the company recently induced the town to buy its plant. In another case the little business done by the company was profitable, but seemed to be done with reluctance, all commercial business was refused, and there was an apparent anxiety on the part of the company to do as little street lighting as possible; a municipal plant was the natural result. I have in mind one case where the business seemed to have assumed as a matter of politics. I am inclined to believe that community will probably find the experience a sad and very expensive one.

The meeting adjourned to convene at 10 A. M., June 14.

TUESDAY'S PROCEEDINGS.

President Copeland called the convention to order at the City Hall, Duluth, at 10 A. M., June 14, and Mayor Henry Truelson, of that city, delivered the welcoming address, which was responded to by President Copeland. The paper by Mr. William Smith Horry, of Chicago, on "Electric Smelting of Ores," was read by Mr. Doherty in the absence of Mr. Horry. Some discussion over question-box inquiries was participated in by Messrs. Wurts, Dee, Pierce, and others. Afterward the convention was addressed by Prof. Gray and Prof. Fujioka of Japan.

Votes of thanks were extended to Mr. J. M. Hill, who had arranged for the boat trip from Chicago to Duluth, to Mr. Jas. R. Dee for his management of the entertainment at the Calumet mines and to the Mayors and citizens who had welcomed the party at different points along the line. A vote of thanks was also extended to the owners of the steamer "Northwest" for courtesies shown and in appreciation of the treatment that visitors had received. The convention then adjourned its midsummer meeting, sine die.

Northwestern Convention Notes.

A handsome cut-glass pitcher, given by Libby & Sons, was won by one of the ladies, who proved to be the best player of shuffle-board on the boat.

Mr. J. M. Hill, who was in charge of the transportation of the Northwestern Electrical Association, was presented with a beautiful scarf-pin by the appreciative travelers.

Mr. Arthur Warren, of the Westinghouse Electric and Manufacturing Company, New York and Pittsburgh, traveled with the party as far as the Calumet mines, returning East from that point.

Mr. Edward B. Kittle, manager of the Chicago office of the Sprague Electric Company, represented his company at the convention of the Northwestern Electrical Association at Duluth and on the boat en route.

Mr. Thomas I. Stacey, of the Electrical Appliance Company, of Chicago, and Mrs. Stacey were members of the steamboat and Duluth party. Mr. and Mrs. A. J. Wurts, of Pittsburgh, were also participants in the interesting trip.

Mr. J. M. Hill received many compliments over the arrangements of the trip. It required a great deal of hard work to successfully carry through the innumerable details. Mr. Hill was accompanied by Mrs. Hill and her mother, Mrs. S. D. McDonald.

Mr. Guy V. Williams, of the Columbia Incandescent Lamp Company, St. Louis, attended the convention of the Northwestern Electrical Association and participated in the boat ride from Chicago to Duluth, making many friends for himself and the company.

President F. N. Phillips, of the American Electrical Works, of Providence, and his western manager, F. E. Donoghue, of Chicago, were greatly interested visitors at the copper mines. Mr. Phillips is a very extensive user of copper, and was warmly welcomed by the officials of the copper companies.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

FIFTEENTH GENERAL MEETING BEGINS AT OMAHA ON JUNE 27—THE PRELIMINARY PROGRAMME.

The fifteenth general meeting of the Institute will be held at the Millard Hotel, Omaha, Neb., beginning on Monday, June 27, at 10 A. M. Daily sessions from 10 A. M. to 1 P. M. continued Tuesday, Wednesday and Thursday. The following papers will be presented:

"Inaugural Address," by the president, Dr. A. E. Kennelly, of Philadelphia.

1. "The Dielectric Strength of Air," by C. P. Steinmetz, of Schenectady, N. Y.

2. "Two-Wire Distributing Systems and Lamps at 220–240 Volts," by John W. Howell, of Newark, N. J.

3. "A Capillary Electrometer for Electrical Measurements," by Chas. F. Burgess, of Madison, Wis.

4. "Alternating-Current Transformers from the Station Manager's Viewpoint," by W. F. White, of Omaha, Neb.

5. "The Graphical Treatment of Alternating Currents in Branching Circuits, with Special Reference to the Case of Variable Frequency," by Dr. H. T. Eddy, of Minneapolis, Minn.

6. "Some Phases of the Rapid Transit Problem," by Albert H. Armstrong, of Schenectady, N. Y.

7. "The Evolution of the Line Signal," by Arthur V. Abbott, of Chicago.

8. "The Commutated Curve of a Composite-Wound Alternator," by D. C. Jackson, of Madison, Wis.

9. "Alternate Current Working for Laboratory and Testing Purposes," by Harris J. Ryan, of Ithaca.

10. "High-Voltage Power Transmission," by Charles F. Scott, of Pittsburgh, Pa.

11. "Preliminary Report of Committee on Standardization," Dr. Francis B. Crocker, chairman.

12. "Transmission and Distribution of Power for Railway Service," by Ernst J. Berg, of Schenectady, N. Y.

13. "The Education of Electrical Apprentices and Journeymen," by Arthur A. Hamerschlag, of New York city.

14. "Air Gap and Core Distribution—The Magnetic Flux and Its Effect upon Regulation and Efficiency of Dynamo Electric Machinery," by W. E. Goldsborough, of Lafayette, Ind.

15. "The Imperial Electric Light, Heat and Power Plant, of St. Louis," by George A. Damon, of Chicago.

16. "Some Tests with an Induction Generator," by A. F. McKissick," of Auburn, Ala.

Members from Chicago and the East should arrange to leave Union Station, Chicago, by the 5.50 P. M. train on the Chicago, Burlington & Quincy Railroad, Sunday, June 26. In order to make this connection, members from New York and the East should leave New York city by the 1 P. M. train on the West Shore Railroad, Saturday, June 25, which is due at Chicago 4 P. M., June 26. Foot Franklin street, New York, 12.45 P. M.; West Forty-second street, 1 P. M.

Members will avail themselves of the special excursion rate fixed for the Trans-Mississippi Exposition, which is $14.75 from Chicago to Omaha, or $48.50 from New York to Omaha. These round trip tickets will be good until July 5, or by special indorsement until August 30.

Mr. S. S. Stout, the well known patent attorney of Chicago, is seriously ill at St. Joe, Mich., and, according to latest reports, his friends and relatives despair of his recovery. Mr. Stout for some years past has made telephone patent litigation a specialty, and has achieved considerable prominence through the able and successful manner in which he defended his clients' interests in the Watson and Roosevelt patent cases. It is sincerely hoped that his present illness may take a turn for the better.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

(*Continued from page 402.*)

have a much greater margin for overload for short periods than direct-current generators. The efficiency at average load, or the all-day efficiency of the No. 2 alternating-current system, is also shown to be appreciably higher than the direct-current. In large central stations the average load is generally found in practice to vary from about 15 to 20 per cent of the maximum, and it will be noted that from 12 per cent average load up, No. 2 curve for the special system of alternating-current distribution shows a higher efficiency than the direct-current.

It may be asked what effect the aging or fatigue of the transformer iron will have on these figures. I answer, none appreciable. Transformer manufacturers are willing to guarantee as low as one per cent increase per year in iron loss. This means one per cent of the actual amount of energy lost in the iron, so that, if this increase continued at the same rate, it would take 100 years to double the iron loss. Experiments tend to show, however, that this effect rapidly approaches a maximum, and that, therefore, the increase goes on at a constantly decreasing rate. The entire effect may be eliminated, if desired, about once in five years by reannealing the transformer iron at a very small expense.

It has been the practice in some European stations to cut out transformers during periods of light load, but it will be seen that cutting out transformers in the system described would only decrease the efficiency; in fact, the efficiency is higher at about the average load, and the system was designed throughout to accomplish this result.

The less we say about curves Nos. 3 and 4 the better, as at small loads the efficiency is shown to be appallingly low.

Several large three-wire, direct-current Edison stations are beginning to employ alternating current to extend their lighting territory beyond that possible or profitable with low-tension current. This is a recognition of alternating current which would not have been considered for a moment a few years ago. They now propose to use alternating current to transmit their energy at high potential to a distant sub-station, where it will be transformed to a lower pressure and then again transformed by means of rotary transformers to direct current, which is in turn distributed over the three-wire Edison system as if generated in the ordinary way. This is a very beautiful and instructive application of alternating currents and ingeniously designed machinery. It gives the manufacturers a chance to sell additional machinery, swells the company's real estate investment, and gives work to the unemployed to operate the sub-stations.

The loss in the conversion to alternating current and back is about 15 per cent, in addition to the loss in static transformers and lines. This distribution might be accomplished without the additional machinery, wire, real estate, labor and loss in efficiency. It is hardly to be expected, however, that those who have grown up under the protection or influence of direct current would use alternating current any further than absolutely necessary until they have grown more accustomed to the new mode of travel. After looking across the stream to coveted territory for many years, they are willing to use the new bridge and to ride across at about the highest speed provided, but when they get on the other side they are more than satisfied to foot it again the rest of the way.

A much higher efficiency of distribution, and better regulation, could be secured by using the alternating-current system as it is, without transformation to direct-current, and everything could be controlled from the main station without employing labor or apparatus at sub-stations. Why do they not use it so? They say that many things can not be accomplished as well with alternating current. If that is a challenge, we will accept it and try conclusions with them. Let us then anticipate these various objections and see what they amount to.

We have already seen how a properly designed system of distribution for alternating currents may be made to exceed the direct-current system in efficiency, taking the latter under its most favorable conditions. If we then add to the usual losses in the direct-current system the losses in double rotary transformation and in static transformers, the very great difference in favor of the alternating current is still more marked.

It has been shown how very simple and reliable regulators can be provided for each alternating-current feeder, which will secure the closest possible regulation over any range desired, and this can be effected at a loss of less than one per cent. Such close regulation can only be secured with direct current by the use of a number of generators connected to auxiliary bus-bars, or by connecting the feeder ends to adjustable resistance connected between the busses of two or more generators. The first can not be realized in a rotary transformer station, and the last is quite wasteful of energy. Regulators placed on the alternating-current feeders of the rotary transformers control alike the pressure on each rotary, and all the direct-current feeders supplied by the same, in exactly the same way as field regulation does on a direct-current generator. Such regulation can only be effectual with a number of small rotaries not operated in multiple. The best regulation can, therefore, undoubtedly be secured with the alternating-current system.

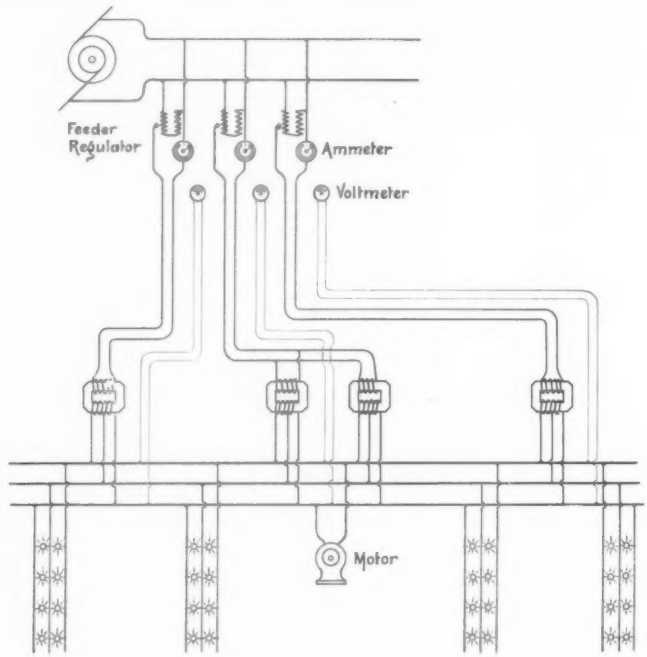

FIG. 2.—SINGLE PHASE A.C. SYSTEM

with High pressure Feeders and low pressure distribution—Independent Feeder for each Transformer or Group.

It seems now to be the universal opinion among Edison station men that the enclosed arc, long-burning lamp is destined to replace all the old forms of arc lamp. We will, therefore, consider this type of lamp only. Fully as well-burning lamps of this type are now made for alternating current. They are also about as free from noise as the direct-current lamps. Many will say, however, that it is impossible to get as much light from the alternating current as from direct current. That is true if we state that the same energy in the arc produces less light with alternating current than with direct current. It has been determined that the alternating-current arc produces about 70 per cent of the light to be obtained from the same number of watts in the direct-current arc. The usual direct-current enclosed arc requires five amperes at 115 volts, or 575 watts. How much of this is used in the arc? Somewhat less than 80 volts or under 400 watts; the balance of over 175 watts being wasted in resistance.

With alternating current, 70 per cent of the amount of light would be obtained with this 400 watts or about 570 watts would be required to produce the same light. The alternating-current arc is best operated at about 70 volts, but inductive resistance is used to bring the pressure down to this amount. This inductive resistance consumes about 10 watts' actual energy, making in all 580 watts, against 575 for the direct current for the same amount of light. This difference of five watts, or less than one per cent, is insignificant.

The standard alternating-current enclosed arc consumes about 420 watts at the lamp terminals, but I have had made to order a large number of 550-watt lamps, which have replaced many series 10-ampere direct-current lamps. There are certain kinds of arc lighting to which the alternating current is particularly well adapted, of which I will speak later on.

The greatest argument used against alternating current used to be that it would not run a motor. It has long ago proved that it can, and that without a commutator. This subject now brings us to multiphase systems. There are two of these systems in general use, the two-phase and the three-phase. Other systems are but modifications of these and will be mentioned as such. Motors can be operated with equal facility and efficiency on either system and have many distinct advantages over direct-current motors.

For long-distance power transmission the three-phase system shows an economy in copper; but for lighting, or for lighting and power combined, it is not at all well suited. I might say that where lighting is a distinct feature, and first-class service is to be rendered from a large station, the three-phase system can not be used successfully. On even the best generators the windings are so entirely interdependent that a change of load on one phase will affect the pressure on the other two; but a defect even worse is the impossibility of regulating the phases independently for drop in the feeders if the load happens to vary differently on any two. Any regulator placed in circuit with one phase will effect about the same change of pressure in the adjacent phase within the usual limits of regulation. Regulation is then a question of the best possible averages, and at best is but guesswork. With the feeder and transformer drops found economical in practice, it would be practically impossible to

keep the pressure sufficiently constant for high-efficiency lamps. The complication of wiring is also very serious, especially if the Edison three-wire system is used for distribution, as six wires would then be required, forming six circuits that must be kept balanced.

The two-phase system is subject to the same objections unless the two phases are used separately for lighting, in which case we have the complication equivalent to twice the number of generators and feeders.

For good regulation and simplicity the single-phase system can not be equaled by any multiphase system.

The so-called monocyclic system is a modified two-phase system in which current is distributed for lighting on a single-phase circuit only, and a third wire carries current in quadrature to the first, which, in connection with the first, is transformed to a three phase relation wherever it is desired to operate motors. The regulation of this system can be made almost as good for lighting as the single-phase, and can be as simply effected. The third wire adds complication, but no balancing is required, as all the lighting is done from single phase on two wires. If low-tension, three-wire distribution is attempted with this system, a fourth wire must be used for power distribution.

A system practically the counterpart of the monocyclic is the three-wire, two-phase system, in which the lighting is all done on one single phase, and a third wire is used in conjunction with the other two for power. It is handled in exactly the same manner as the monocyclic system, the only practical difference being in the relative potential of the quarter-phase circuit. In the monocyclic, the quarter-phase element of the generator winding is one-fourth the potential of the main winding, giving between the power line and the main lines a pressure of 55 per cent of that between the main lines themselves. In the special form of three-wire, two-phase, the quarter-phase element of the generator winding is equivalent to one-half of the main winding, which causes a pressure between power line and main lines 71 per cent of that between the main lines. For power distribution this system requires slightly less wire than the monocyclic. Fig. 3 shows diagrammatically the arrangement of this system used in connection with the special method of distribution already described. The diagram shows a system of two-wire mains for lighting, to which might be applied, of course, the Edison three-wire system. The motors used would most naturally be of the two-phase type, although three-phase motors may be used with equal facility by the method of transformer connections devised by Mr. Scott.

It can be readily seen that while these systems are much better adapted to general station distribution than the two-phase or three-phase, they still lack the simplicity of the single-phase, and both require more wire. Fortunately, we can now obtain single-phase motors which equal the multiphase and direct-current motors in efficiency and almost all desirable points. They start readily with load and may be operated with variable speed; in fact, they equal the direct-current shunt motor in all points, excelling it in efficiency and simplicity.

We can meet the direct-current advocates on the power question, therefore, on at least an equal footing, save only one application met in central station practice; namely, the operation of high-speed elevators. The alternating-current motor, multiphase or single-phase, can not be controlled for this work as readily as a compound series, direct-current motor. It has taken several years, however, to perfect the mechanism for the control of direct-current elevator motors. Give us the same time, and we will do it with alternating current. This field for power has only of late been opened to direct-current stations, and it is yet a question for debate as to whether it is a paying one.

There are many special applications of current met with in practice, most of them bringing a small return, such as electro-plating, electro-cautery, charging small storage batteries, electric heating and cooking, etc. The first three require low-potential currents, and are economically effected only by motor generators or rotary transformers. It is evident that this transformation can be accomplished as readily with alternating current as with direct current. Electric heating and cooking are as yet luxuries, and can not be depended on for much revenue. They can be done with equal facility by alternating current.

Here we come to the direct-current advocate's last and greatest stronghold. To this he retreats with great confidence of safety. We may ask first whether storage batteries have yet been proved to be a valuable adjunct to the central station, cost and maintenance considered. It is true they are being tried by several large stations, and we watch eagerly for the results. They equalize the station load to a greater or less degree, and cut down the generator capacity for the peak. Are they, however, cheaper than generators, engines and boilers of the same capacity? Are the losses in transformation less than the cost of a few more attendants? Is their maintenance less expensive than that of generating apparatus? These questions can not as yet be answered in the affirmative. But if the battery man's most sanguine hopes be realized, what then? If rotary transformers are good enough for the direct-current man to use to change the direct current to alternating current, transmit a good proportion of his load to a distance and transform again to direct current, why should not the alternating-current man use them to charge his batteries and then to transform their output back to his pet form of current? Loss in transformation, do we hear some one say? Not any more than with our contemporaries' long-distance transmission system, and in this instance they are small and unimportant, we are told. There is at least one station in the country where storage batteries are being used in this way, and I believe with success, as storage batteries go.

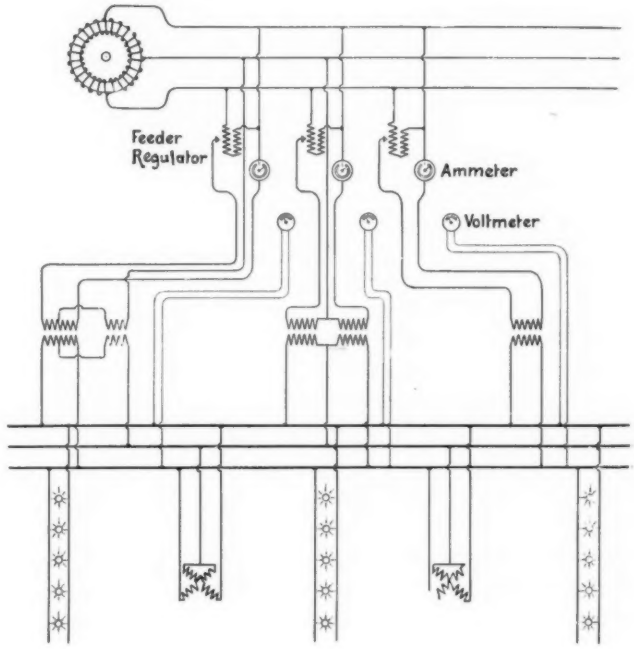

FIG. 3. THREE WIRE TWO PHASE SYSTEM
with single phase lighting.-High pressure Feeders; low pressure distribution.

Have our direct current friends anything more to bring forward? Or have we forced their last position? Well, we will declare a truce, and acknowledge that they fight bravely. We have learned as much from them as they can learn from us. If we had been as quick to acknowledge their beautifully designed distributing details and applications as they have been to appreciate a few of the advantages of our current, we might have been nearer together, or even hand in hand, long ago. As it is, we are both working to the same end, and our paths must join sooner or later as they converge.

Before closing, I wish to recapitulate a little, and draw your attention more forcibly to the flexibility of the alternating-current system. We all know of the many applications to which this current is now put, and what we have described here is, most of it, not new to many of us. The use of the rotary transformer has been widely talked of and described for the last two years. The facility of operating lines at any potential desired, through the means of step-up and down transformers, is no longer an experiment. Multiphase motors are familiar to all, while single-phase motors have been much talked of and written about, and failures have, time and again, followed boasted success. Many of us, however, have within the last year seen them quietly at work, thoroughly tamed and domesticated. One large station is using them extensively, and is so thoroughly convinced of their success that it has discarded all notion of using multiphase distribution, although it is using generators that can be operated two-phase if desired. Direct-current motors are being rapidly replaced by these single-phase motors to secure uniformity of system.

Arc lamps have been familiar to us on alternating-current circuits for some time, and the alternating-current, enclosed, long-burning arcs are now numbered by the thousands. Street lighting is still, however, in most places done on the direct-current series system, and even the largest machines yet built for this purpose are very small in comparison with our large direct-connected generators.

The great desideratum in central-station practice is to be able to employ one system for everything. All current for all classes of service should be supplied from but one type of generator, be this direct-current or alternating-current. In this way only can the maximum output be accomplished from a given investment in machinery and apparatus, and the greatest economy in operation secured. This has been accomplished in many stations where a limited range of service is to be provided. Arc lighting has, of all, been the most troublesome to provide for. How shall we operate our arc lamps from our incandescent lighting system, has been the anxious

(Concluded on page 408.)

Electrical Review

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SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

Views, News and Interviews..... 401
National Electric Light Association..... 401
Northwestern Electrical Association..... 403
American Institute of Electrical Engineers..... 403
Alternating or Direct..... 406
Wall Street and the Electrical Stock Market.... 406
Fan Motor Patent Litigation..... 407
Canadian Electrical Association..... 407
Personal..... 407
Prominent Rheostat Manufacturers Combine.. 407
Siemens & Halske Annual Election..... 407
General Distribution from Central Stations by Direct Currents..... 408
Telephone News and Comment..... 412
Lachine Rapids Plant and the Cost of Producing Power for Generating Electricity Therefrom..... 413
Advance Information..... 414
The British Volunteer Electrical Engineers..... 414
The Underground Trolley in New York City.... 414
Kindred Interests..... 415
Electrical Patents..... 416

Advertisers' Alphabetical and Classified Index on page xii.

The auxiliary cruiser "Yankee," which is manned by the New York Naval Militia, is receiving high praise from all quarters for her courageous attack and accurate shooting at the recent bombardment of Santiago. A number of electrical men are serving on the "Yankee," and Lieut. S. Dana Greene, of the General Electric Company, is one of her officers.

It is proposed to hold an International Electrical Exhibition at Como, Italy, in 1899, to celebrate the invention of the electric pile by Alexander Volta. The preliminary schedule states that all classes of apparatus will be received for exhibition, including both the technical and practical sides of the industry.

The First Regiment of Volunteer Engineers, under command of Col. Eugene Griffin, has been ordered into camp at Peekskill, N. Y., where they will receive their preliminary military training. A fine body of men, both officers and privates, has been selected with great care from a large number of applicants, and great things are expected of them when they are called into active service.

The Northwestern Electrical Association departed from the usual custom of meeting on *terra firma*, and held the greater part of its convention on board the palatial steamer "Northwest," en route from Chicago to Duluth. This arrangement included a very excellent combination of sight-seeing, convention proceedings and enjoyable water ride. The travelers were well entertained at all points visited. The association concluded its proceedings in Duluth on Tuesday, June 14.

The general meeting of the American Institute of Electrical Engineers, which opens at Omaha on June 27, promises to be one of the most important sessions held by that body. The preliminary programme shows that the addresses and discussions will be of great value technically. While the place of meeting is a considerable distance from New York, the home of the Institute, it is expected that the western members will attend in full force, as was the case at the recent convention of the National Electric Light Association held at Chicago. The fact that the annual meeting of the Institute is held at Omaha during the Trans-Mississippi and International Exposition adds to the pleasure of the occasion. Favorable railroad arrangements have been made.

ALTERNATING OR DIRECT?

Alternating versus direct-current central station practice occupied the attention of the National Electric Light Association for nearly a whole day at the recent Chicago convention. Mr. Wagner appeared as the champion of the alternating current, while Mr. Ferguson presented the arguments of the direct-current advocates. The addresses of both these gentlemen were provocative of great interest, as was evidenced by the prolonged and intelligent discussion by competent central station men which followed. In our opinion, it is evident that no hard and fast lines can be drawn to circumscribe the field and conditions where one or the other of these systems of generation and distribution can be fixedly determined. It is the belief of those who look ahead that a combined station, where extensive areas of territory are to be efficiently served, will solve more knotty problems than a strict adherence to either doctrine.

The electrical industry is one of several which has been largely benefited by the war. Immense quantities of wire, cable and electric lighting apparatus have been supplied to the navy and war departments, and it is understood that still greater quantities will be required if the plans now under consideration are carried out. Many of the wire and cable factories are still running day and night to fill government orders.

It is certain that there is at least one class of men who are thanking their lucky stars that the electric fan motor was invented. These are the commissioned officers aboard our men-of-war in Cuban waters. The wardrooms and officers' staterooms on many of our war vessels are equipped with electric fans, which add greatly to the comfort and health of those compelled to live in tropical climates.

On Saturday last the Brooklyn Elevated Railroad began running electric cars from the New York side of the New York & Brooklyn Bridge through to Coney Island, the first trip being made in 37 minutes. The day is coming when elevated express trains, operated electrically, will run from the Harlem River to Coney Island in about an hour's time.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The course of the stock market during the past week was characterized by more or less hesitancy. Briefly stated, the large interests sold out their holdings of stock at the recent high level, and were not averse to a recession in values which would enable them to purchase the same stock at a profit. Values did not yield much to the bear attacks, thus reflecting the great confidence felt by the general public in prevailing conditions, both commercial and financial. It now looks as if the great leaders had once more become bulls.

General Electric was not so active as last week. From 39 at the opening it declined to 36¾, subsequently rallying two points. The debenture 5's sold at 103⅜ to 103¼. Many reports regarding the plans under consideration for an agreement with the preferred stockholders have been circulated. It is learned on the highest authority that nothing definite has been agreed upon, and from present indications an agreement will not be reached for some time to come. The delays and difficulties incident to so important a measure are being met with, although there is no reason to doubt the successful accomplishment of the work on hand.

There was no feature to the trading in Western Union. The price fluctuated between 91 and 92¼. The collateral trust 5's sold at 110½ and 111.

Considerable activity developed in North American on Tuesday on reports of a possible dividend by Milwaukee Electric. This, however, was semi-officially denied. The report of the North American Company for the year ending May 31 shows that the total earnings were $50,102, an increase of nearly $11,000 over 1897. Owing to decreased expenses the net earnings were increased even more, aggregating $19,534 compared with $7,739 the previous year. Taxes were less and the surplus was $13,640, an increase of over $12,000 over 1897. The company has no debt and is a lender of money. The report adds that the management expects to get dividends from some of the principal stock investments, which would substantially increase the surplus. The idea of reducing the capital stock has not been abandoned, and the subject will be brought forward to the notice of the stockholders when conditions warrant it.

Insiders are bullish on Manhattan. A director of the company told me

that the system would be equipped with the third rail before very long. This substitution of electricity as the motive power is expected to effect a net saving amounting to 2 per cent on the stock. In addition to this the decision on the pending tax case, which is expected this month, will, it is believed, be favorable and will mean 1 per cent on the stock. The elevated is now earning 5 per cent, and with the increases noted above there is reason to believe that it will go back to a 6 per cent dividend basis.

American Telegraph and Cable was quiet at 93 to 93½. Some Edison Electric Illuminating of Brooklyn changed hands at 105¼. The company declared its regular quarterly dividend of 1½ per cent. Edison of New York 1st 5's sold at 111. A director of the company is quoted as saying that no increase in the 6% dividend rate will be made but that another issue of new stock some time next year is among the probabilities.

Trading in electrical stocks in Boston during the week was more narrow than for some time past. American Bell Telephone on Monday touched 275, sold down to 267 on Tuesday, rallying later in the day to 272½, reacting to 267½ on Thursday. Erie Telephone ranged between 68¼ and 70. New England Telephone was quiet between 131 and 132. Westinghouse common sold at 23 and the preferred at 53½ to 54.

During the month of May 384 new subscribers were added to the Erie Telephone and Telegraph Company's system.

Electric Storage Battery stocks were moderately active in Philadelphia, opening at 22½ and selling up to and closing at 25 for the common, while the preferred changed hands between 25¼ and 28, closing at the latter figure. The advance at the close was attributed to reports from Paris to the effect that the General Cab Company of that city had adopted the Electric Storage system as a motive power, and had ordered 100 new cabs to be equipped with the storage batteries, and would eventually convert all its cabs to the same system. Pennsylvania Manufacturing Light and Power, on heavy transactions, advanced ¾ point to 16. RAY.

Wall Street, June 18.

Fan Motor Patent Litigation.

The Diehl Manufacturing Company, of Elizabethport, N. J., has issued a circular to the trade conveying the information that it has commenced suit against Royce & Marean, of Washington, D. C., for alleged infringement of the following patents on electric fans: Nos. 465,360, 465,361, 537,679 and 585,250.

Canadian Electrical Association.

The annual convention of the Canadian Electrical Association will be held at Montreal, Quebec, on June 28, 29, and 30. The sessions will be held in Convention Hall of the Windsor Hotel. The social features of the meeting have been arranged by a local committee composed of the most prominent local electrical men. The annual banquet will take place on the evening of June 29 at the Windsor Hotel. The programme of the meeting is as follows:

TUESDAY, JUNE 28.

9.30 A. M.—Meeting of Executive Committee.
10 A. M.—Opening of first session in Convention Hall, Windsor Hotel.
President's Address
Reading Minutes of Last Meeting.
Secretary-Treasurer's Report.
Reports of Committees and General Business.
2 P. M.—General Business.
Presentation of Papers.
Discussion.

WEDNESDAY, JUNE 29.

9 A. M.—Consideration of Reports of Committees.
Election of Standing Committees
Selection of Place and Time of next Meeting.
General Business.
Presentation of Papers.
Discussion.

THURSDAY, JUNE 30.

9.30 A. M.—Election of Officers.

LIST OF PAPERS.

"How to Overcome Some of the Difficulties Encountered by Central Station Men"
A. A. Wright, Renfrew, Ont.
(1) "The Unconscious Ownership of an Important Key."—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways.)
(2) "The Quimby Screw Pump."
W. T. Bonner, Montreal.
"Experiences of an Inspector."
Dr. J. K. Johnstone, Inspector of Electric Light, Toronto.
"The Electric Current in the Rainy River Gold Mines." W. W. Hopkins, B. Sc., C. E., etc.
"The Importance of Proper Methods of Illumination."
F. A. Bowman, M. A., B. E., New Glasgow, Nova Scotia.
"Electric Utilization of Water-Powers."
Louis DeWitt Magie, Montreal.
"Economies in the Boiler-Room."
James Milne, Toronto.

SOCIAL FEATURES.

TUESDAY, JUNE 28.

7.30 P. M.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on Mountain to view the city under illumination.

WEDNESDAY, JUNE 29.

1 P. M.—Visit to (1) Bell Telephone Company's new building; (2) street railway company's power-house; (3) power-house and works of the Lachine Rapids Hydraulic and Land Company, returning to city at 7.30 P. M.
9 P. M.—Annual Association Banquet at Windsor Hotel.

THURSDAY, JUNE 30.

11 A. M.—Visit to McGill University.
1.30 P. M.—Visit to Royal Electric Company's lighting station and factory, then by special Grand Trunk train to visit the works of the Chambly Manufacturing Company at Chambly.

PERSONAL.

Capt. Edward B. Ives, a well known electrical and civil engineer, is recruiting a signal corps for the regular army in New York city and Brooklyn.

Mr. J. E. Keelyn, president of the Western Telephone Construction Company, of Chicago, was among the out-of-town visitors to New York city last week.

Prof. I. J. Macomber, of Cornell University, has been appointed professor of electrical engineering in the Armour Institute of Technology, Chicago.

Capt. W. L. Candee and Geo. T. Manson, of Okonite fame, are home again after having passed an enjoyable week attending the National and Northwestern conventions at Chicago.

Mr. E. H. Abadie, of the Wagner Electric Company, rested a day in Chicago last week, having returned from the Duluth trip. Mr. Abadie states that the convention was one of the most enjoyable affairs he ever attended.

General Superintendent J.J. Nate, of the Standard Telephone and Electric Company, ran into Chicago during convention week, arriving just in time to catch the Northwestern Convention steamer by taking a fast train to Milwaukee.

Mr. Arthur R. Pardington, of the New York & New Jersey Telephone Company, Brooklyn, N. Y., has received his commission as acting paymaster, with the rank of lieutenant, in the United States Navy, and has been sworn into the regular service.

President G. A. McKinlock, of the Central Electric Company, Chicago, having duly contributed his share towards making the two conventions a success, is at his desk again disposing of accumulated business, which even during a few days' absence has assumed almost alarming proportions.

Mr. F. N. Bosson, the well known electrical engineer of the Calumet and Hecla mines, extended a hearty welcome to electrical visitors to the mines last week, and met many old friends in the party. Mr. Bosson has entire charge of the extensive electrical interests of the company, and has a very fine lighting and power plant installed.

Mr. Chase Osborne, of Sault Ste. Marie, Mich., the leading editor of northern Michigan, visited the electrical party on board the "Northwest" last week, and assisted in the cordial welcome extended to them by his city, where a magnificent four-sided evergreen arch, lighted by incandescent lamps and bearing the illuminated word "Welcome," had been erected.

Mr. James R. Dee, of Houghton, Mich., a member of the executive committee, was quite active and considerate in welcoming the electrical visitors of the Northwestern Electrical Association to his part of the country. Mr. Dee also enriched the repertoire of a number of story-tellers from the East by the addition of several local stories that are now destined to become national.

PROMINENT RHEOSTAT MANUFACTURERS COMBINE.

CONSOLIDATION OF AMERICAN RHEOSTAT COMPANY AND CUTLER-HAMMER MANUFACTURING COMPANY.

Arrangements for a combination between two of the largest rheostat manufacturers of this country were completed a little over a week ago, whereby the offices and manufacturing plant of the American Rheostat Company, heretofore at Milwaukee, were transferred to Chicago and combined with the business of the Cutler-Hammer Manufacturing Company, whose name will be used for the combined interests. The officers of the new Cutler-Hammer Manufacturing Company are: Frank R. Bacon, president; Fred L. Pierce, vice-president; J. G. Hickcox, treasurer and purchasing agent, and H. H. Cutler, manager of the engineering department. The names of Messrs. Bacon and Hickcox will be recognized as having held similar positions with the American company, and their practical experience and good judgment will be of much value to the concern. The ability of Mr. Harry Cutler as an electrical engineer is so widely known as to make further mention unnecessary. With the resources of the two concerns merged into one the new company will undoubtedly command the greater share of the rheostat business.

Siemens & Halske Annual Election.

The annual meeting of the stockholders of the Siemens & Halske Electric Company, of America, was held on June 16, at their offices, Monadnock Block, Chicago. Nearly the entire capital of the company was represented at the meeting and the following gentlemen were elected directors of the company: Chas. T. Yerkes, Martin Maloney, Jno. R. Bartlett, R. Suydam Grant, Charles E. Yerkes, E. A. Moore, B. W. Grist, Howland Coit and W. L. Elkins, Jr.

The new board of directors was organized, and the following gentlemen were elected officers of the company: Chas. E. Yerkes, president; W. T. Block, secretary and treasurer; C. F. Marlow, assistant secretary and assistant treasurer; B. W. Grist, general manager. The following gentlemen compose the executive committee: Martin Maloney, Chas. E. Yerkes and J. R. Bartlett.

Mr. Englund, of Mayer & Englund, Philadelphia, spent a few days of last week in New York city.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

(Concluded from page 405.)

inquiry. The constant-potential arc lamp has answered this question for commercial lighting, but city street lighting can not be so easily provided for. The Edison companies have done a limited amount of this from their three-wire system, but this can be done to advantage only in districts where mains have been provided for commercial lighting. For extended arc lighting, the small series machine with its belts and clutch pulleys still holds the fort.

I am able to state, however, that one large company has recently solved the problem to its entire satisfaction. This company furnishes 2,600 street lamps to the city, lighting some 300 miles of street. These were operated by a small army of series arc machines. They were installed by a company that was acquired by purchase by the one first mentioned. As this company had long since adopted alternating current for its entire distribution, it was extremely desirable to be able to operate these city lamps from its large direct-connected alternators, thereby saving in fuel, attendance, floor space and reserve investment.

After a few months' trial of an experimental circuit with alternating current, it was found perfectly feasible to operate the same direct-current lamps, slightly remodeled, on the same circuits of 60 or 80 lamps in series. A system of this kind was therefore adopted and the company now has 2,300 of these lamps in regular operation by alternating current in this way. The circuits are each provided at the station with a regular step-up transformer of a maximum capacity of 4,000 volts and 10 amperes, and the feeders to these transformers are treated on the switchboard in the same way as the feeders for incandescent lighting. It is quite usual for one generator to carry 2,000 of these lamps. The lighting is satisfactory to the city and the lamps give better service than when operated by direct current. There has been a very marked saving in fuel and attendance. The indicated horse-power per arc lamp is considerably less than with the direct-current arc lamps operated in the usual manner. Fig. 4 shows this system in diagram.

I know of no other place where this is being done, and it stands as a very pronounced example of the flexibility and adaptability of alternating currents.

There have been a great many problems in the operation of large alternating-current stations that have been discouragingly difficult of solution. The handling of high potentials on switchboards, the operation of generators in multiple, with facility, and scores of more or less important difficulties, have, one by one, been surmounted, the burden of the work usually falling on a few of the pioneer stations.

In summing up, we find the following marked features in which the alternating current, properly installed, has been shown to have pronounced superiority over the direct current:

Highest possible efficiency of distribution and operation.

Best regulation.

Largest territory desired readily supplied from one station.

Comparatively small cost of feeders, effecting enormous saving in investment.

Least cost of real estate.

Cost of installing and operating sub-stations entirely voided.

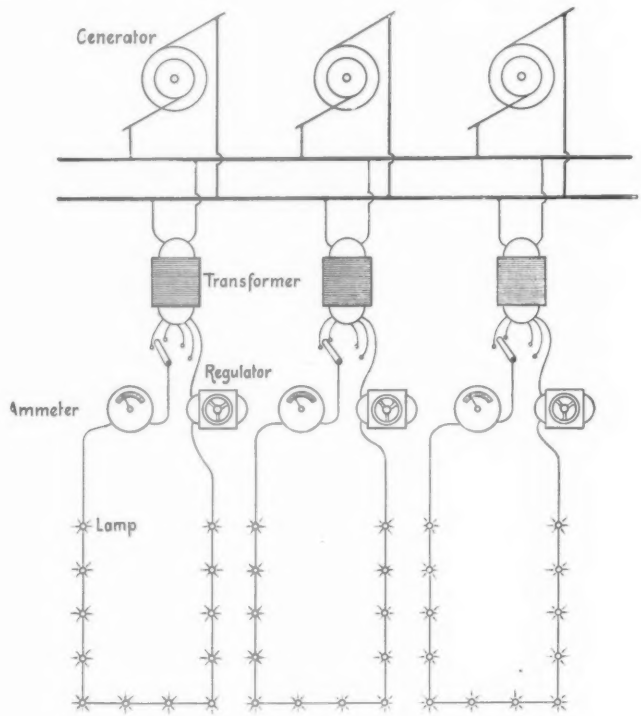


FIG. 4. A.C. SERIES ARC-LIGHT SYSTEM.

The only system in which all classes of service can be supplied from one type of generator.

Greatest flexibility.

In closing, I wish to thank my friends and co-laborers of the direct-current faith, from several of whom I have had the pleasure of learning much that has proved of great value to me.

GENERAL DISTRIBUTION FROM CENTRAL STATIONS BY DIRECT CURRENTS.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, CHICAGO, JUNE 8, 1898, BY LOUIS A. FERGUSON.

The subject of central station distribution by direct currents is one which is so familiar to many of you that I hesitated when asked to write this paper, feeling that it would be difficult to present to you any new thoughts or experiences, so I trust you will pardon me if in the attempt to precipitate discussion and bring to the attention of the meeting the ideas and experiences of others, which is after all the object of my paper, I may trespass upon ground previously explored.

Nor do I wish to be construed as advocating blindly the general use of direct currents under all conditions, for both transmission and distribution of electricity for lighting and power purposes in cities and towns, for records will, I think, clearly show that the writer was the first of the so-called Edison central station men (who have represented the direct-current idea in central station lighting) to advocate the introduction of the alternating current as a means of affecting important economies in the operating of the direct-current distribution systems, and also vastly extending their field of operation, which, without the combination of alternating currents, might have remained, despite their distinct advantages, unfortunately limited to a comparatively small and closely populated area.

The general design of the modern direct-current central station and its equipment have been fairly well established within the past five years, and while it was originally the custom to erect the generating stations as nearly as possible in the electrical center of the city or town, it is now generally conceded that direct current may be more economically distributed from a condensing station, situated even a mile distant from the electrical center than from a non-condensing station located at the electrical center of the city, and it has been further demonstrated that the former practice of building many central generating stations in various centers of distribution in cities is to be supplanted by the use of one or two large condensing stations generating direct current for distribution throughout the business district, if the station be within one mile of the electrical center of the district, and alternating current for transmission to sub-stations located at the electrical centers of districts more remote from the main generating station. In some cities water for condensing purposes may not be easily obtainable within a distance of one mile, and the location is then merely a question of total cost of land, building and transmission lines to the various distributing stations, proper consideration being given, of course, to the limitations of line voltage and insulation.

In order to show the workings of the first-mentioned type of modern direct-current central station systems, I will explain in a general way the method of distribution employed in the system of the Chicago Edison Company, which, I think, fairly represents the latest development in direct-current distribution, and leave the explanations of the methods of direct-current distribution in other cities to the representatives of the companies operating them.

The system of distribution is a solid network of underground conductors on the three-wire system, extending from North avenue to Thirty-ninth street, a distance of six miles north and south, and from Lake Michigan to Blue Island avenue, a distance of one and one-half miles east and west. The entire network is continuous from end to end, and is supplied at present from four central stations, all connected in parallel through the network and each feeding into it. The two large stations located at Harrison street and Washington street on the Chicago river, and known as stations No. 1 and No. 5, respectively, are condensing plants, while the stations on the north side and south side, located at North Clark and Oak streets, and Wabash avenue and Twenty-seventh street, known as stations No. 4 and No. 2, respectively, are non-condensing.

The total current furnished to the network at the time of maximum load of the system in the Winter of 1897 was 50,730 amperes, and is divided as follows:

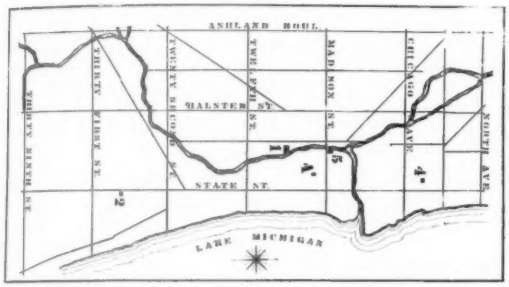
	Amperes.	Per Cent of Total.
Station No. 1	35,600	70.2
Station No. 5	7,600	15.0
Station No. 2	3,400	6.7
Station No. 4	4,130	8.1
	50,730	100.00

The total low tension direct-current kilowatt hours' output for the stations for the fiscal year of 1897 was 15,255,466, divided as follows:

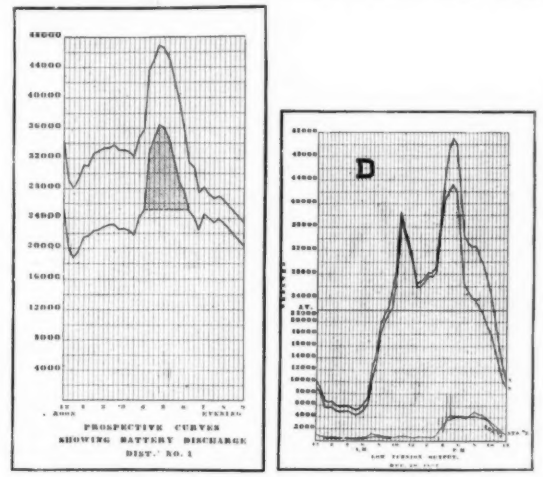
	Low Tension Kilowatt Hours.	Per cent of Total.	Maximum Station Voltage.	Yearly Average Station Voltage.
Station No. 1	11,335,618	74.3	140.	126.2
Station No. 5	2,314,473	15.2	142.5	129.5
Station No. 2	808,158	5.3	125.0	119.0
Station No. 4	797,217	5.2	123.5	120.1
	15,255,466	100.00		

The pressure at the feeder ends throughout the system is maintained at 115 volts on each side of the three-wire system. Although the maximum station pressure is 149 volts, the average pressure of all stations for the year is 126.2 volts, giving an average loss of pressure of 11.2 volts, or 8.8 per cent, which means an average yearly efficiency of distribution of 91.2 per cent from the station switchboards to the customer's meter.

The center of distribution in the business district of the city is at Adams street, between Clark and La-Salle streets. Station No. 1, which, as has been shown, furnishes 74.3 per cent of the total low-tension output,



CHICAGO EDISON COMPANY'S AREA OF DISTRIBUTION.



LOAD CURVES, CHICAGO EDISON COMPANY.

is located on the Chicago river at Harrison street, 3,340 feet distant from the center of distribution at Adams street. Station No. 5, which furnishes 15 per cent of the total low-tension output, is located on the Chicago river at Washington street, and is 4,500 feet from station No. 1 and 3,000 feet from the Adams street sub-station.

These two stations furnish all the low-tension output for the district bounded by the river on the north, Harmon court (approximately) on the south, Lake Michigan on the east and the river on the west. They also furnish all the energy for the entire low-tension system of the city during the hours from midnight until dusk the following afternoon, and a portion of the output of districts No. 2 and No. 4, from dusk until midnight daily, and ultimately they will furnish all of the output of the territories mentioned, and all of the energy required for alternating transmission lines into the outlying districts of the city and its suburbs.

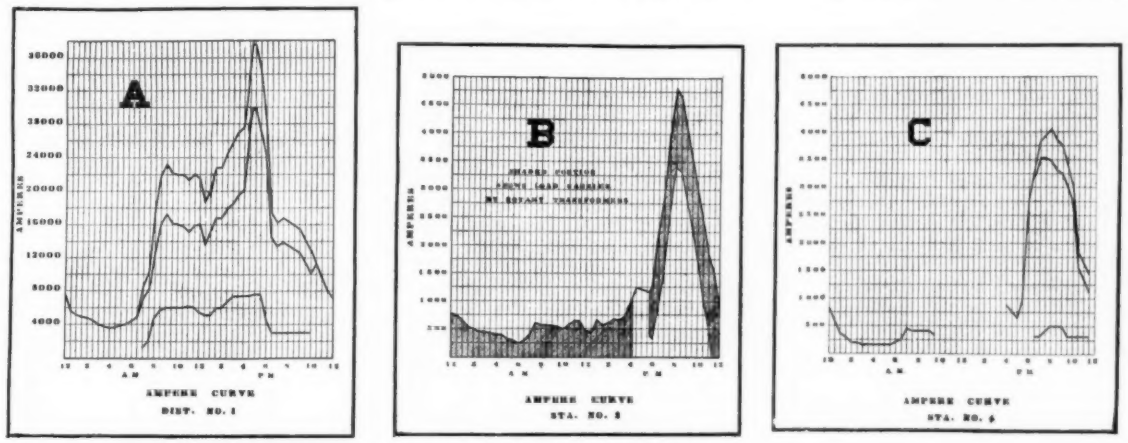
The load curves "A" here shown indicate the amperes furnished in district No. 1 by stations No. 1 and No. 5, the small lower curve representing that delivered by station No. 5, and the lower large curve showing that delivered by station No. 1, and the upper curve representing the total amperes delivered to district No. 1.

The distribution of current from these two stations to the underground network is as follows:

From station No. 1 to the Adams street sub-station is laid an immense trunk line known as the Adams street trunk line, having a total cross-sectional area of 66,000,000 circular mils, 28,500,000 circular mils being ordinarily connected on the positive and negative sides and 9,000,000 circular mils in the neutral. The length of this trunk line is 3,340 feet, and is made up of 15 special Edison tubes, each 3,000,000 circular mils area, laid directly in the ground, and fourteen 1,500,000 circular mils stranded rubber insulated, lead-covered, and juted cables drawn into cement-lined iron ducts. The trunk line on leaving station No. 1 goes down a shaft 60 feet, thence through a brick tunnel built especially for it in the river bed to the east side, where it rises again in another shaft 60 feet into the tunnel-house, where a small switchboard is located. The portion of the trunk line in the shafts and tunnel, which is 430 feet in length, is made up entirely of cables; of these 45 are 1,000,000 circular mils Siemens jute insulated, and 14 are 1,500,000 circular mils General Electric rubber insulated, leaded, asphalted, and iron-armored submarine cables, each supported on iron racks. Where the cables hang vertically in the shaft, the cable is supported by the iron-armored sheathing clasped between iron plates on a heavy cast-iron ring. The copper conductors thus hang in a sort of basket, the strain being distributed throughout the length of the cable. At the tunnel-house the 45 Siemens 1,000,000 circular mils cables connect with fifteen 3,000,000 circular mils single-pole Edison feeder tubes, and together with the fourteen 1,500,000 circular mils cables are mounted on racks in a large subway, into which the duct line enters about 200 feet east of the tunnel-house. At intervals of about 500 feet manholes are built in the Edison tube portion as well as in the conduit portion of the trunk line, thus affording a quick means of locating low insulation points as they develop. Each of the tubes and cables is provided with an amperemeter at station No. 1, and with switches at both ends, so that they may be completely disconnected from the system in case of trouble. Two of the 3,000,000 circular mils tubes are provided with throwover switches and arranged so that they may be quickly connected either to the positive or neutral, or negative or neutral at will. All of the cables are provided with throw-over switches on both ends, so that they may be operated either as positive or negative at will, thus providing for any possible contingency that may arise. At the Adams street sub-station the trunk line feeds into the main bus-bar in the distribution room, and from the switchboard 42 feeders radiate to various points in the business district, ranging in size from 250,000 circular mils to 1,000,000 circular mils, and in length from 290 feet to 2,831 feet, the average size being 485,000 circular mils, and the average length of feeder 1,373 feet.

The maximum current in amperes carried over the trunk line and distributed from the Adams street sub-station last December was 34,400 amperes, the maximum loss of pressure on the trunk line being 12.4 per cent, and to the customer's meter 22.8 per cent, the distance to farthest feeder end being 6,171 feet. In addition to the current furnished to the trunk line, station No. 1 also delivers from its main bus-bar current to the two 1,000,000 circular mil feeders which feed into two points in the southern portion of the business district. One of these feeders terminating at Wabash avenue and Harrison street is 3,800 feet in length and carries with maximum station pressure 780 amperes on each side, the other terminating at Eldredge Court and State street is 4,800 feet in length and carries with maximum station pressure 620 amperes on each side. The supplying of district No. 1 by station No. 5 is done in much the same manner as that just described by the two feeders from station No. 1 into the southern portion of the district. From station No. 5 eight feeders, varying in size from 400,000 circular mils to 1,000,000 circular mils, and in length from 2,175 feet to 4,445 feet, terminating at different points in the northern section of district No. 1, deliver a total of 7,600 amperes at maximum station pressure of 140 volts, the amount of current furnished during the run being only enough to maintain standard system pressure at the feeder ends, the curve of station voltage following very closely that of station No. 1.

Station No. 2, which is now really a rotary transformer sub station, is 17,500 feet from station No. 1, and 14,300 feet from Adams street sub-station. The load diagram "B" shows the amperes delivered to district No. 2, the cross-hatched portion representing the current furnished through the rotary transformers and the unshaded portion representing the current furnished by the dynamos



LOAD CURVES, CHICAGO EDISON COMPANY.

in station No. 2, the dynamos and rotary transformers operating in parallel on the three-wire system. The upper curve shows the total amperes delivered to district No. 2.

Station No. 4, which now operates only from dusk till midnight, and will later become a sub station, is 11,500 feet from station No. 1, 9,000 feet from station No. 5, and 8,000 feet from Adams street sub-station. The load diagram "C" shows the amperes delivered to district No. 4. The portion of the curve from midnight until 3.30 P. M. on the Winter day and until 6.30 P. M. on the Summer day is furnished from district No. 1 through the inter-connected underground network, the district No. 4 being, during these hours, merely an extension of district No. 1, and having no distinct supply delivered through its own switchboard. From dusk till midnight the generating plant in station No. 4 is operated, and the current is delivered, as shown, by the next to the highest curve on the diagram, the low curve marked No. 5 representing the amperes furnished by station No. 5 to district No. 4 over a direct-current tie-line between the switchboards of the two stations. The tie line is made up from one feeder running out of station No. 5, originally feeding into district No. 1 and now connecting, by means of river cables, with a feeder out of station No. 4, which formerly fed into the district at a southern point. This tie-line is also used on dark days to keep up the pressure in district No. 4 by connecting on to the main bus in station No. 5 and allowing it to take a small current and deliver it to station No. 4 switchboard, thus relieving the network between districts No. 1 and No. 4 of some of the work. Between the hours of midnight and eight o'clock in the morning there is only one low-tension direct current generating station operating (station No. 1) supplying direct current to district No. 1, and through the network to district No. 4.

District No. 2 is supplied from station No. 1 by means of a converse rotary transformer connected to the 250 volts, direct-current bus-bars, converting to three phase alternating current at about 160 volts. By means of step-up transformers this is raised to 4,500 volts, and at this pressure the energy is transmitted by three-phase underground transmission line to station No. 2, where it is reduced by step-down transformers to about 80 volts, and converted by means of rotary current transformers to direct current at about 115 volts.

For the permanent conversion of station No. 2 into a sub-station, a pair of special 200-kilowatt generators is being installed, directly coupled to the existing 600-horse-power triple-expansion engines in station No. 1. Each generator is provided with a commutator and a set of three collector rings, and are designed to deliver from the same armature direct currents and three-phase alternating currents, the direct-current sides of each pair of machines being connected in series to form a three-wire unit, and the alternating-current sides, after passing through transformers stepping up to 4,500 volts, being connected in multiple. The alternating current from these machines will be taken to supply the transmission line to station No. 2, and the balance of the capacity of the machines will be delivered directly into the main direct-current bus-bar of station No. 1, thus keeping the unit operating at full load and maximum efficiency during its run. The peak of the load in district No. 2 arrives later than the peak of district No. 1, so that the same investment in steam and electrical machinery may be employed to take care of a portion of the peak in both districts, these special generators constituting a reserve or surplus for the direct-current equipment of station No. 1.

Lest I might wander from the subject of the paper, I shall not now dwell further upon the question of transmission of energy by alternating currents, although it plays an exceedingly important part in the distribution of electricity by the Chicago Edison company.

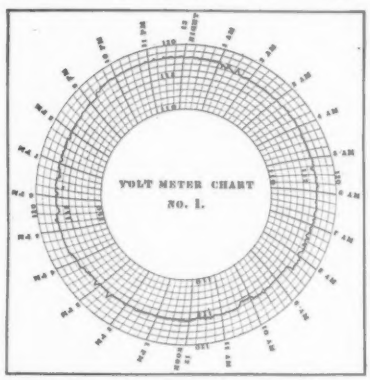


Chart No. 1 represents the pressure for 24 hours on the direct-current distribution system in the business district of Chicago. The average deviation from the mean pressure is less than one volt.

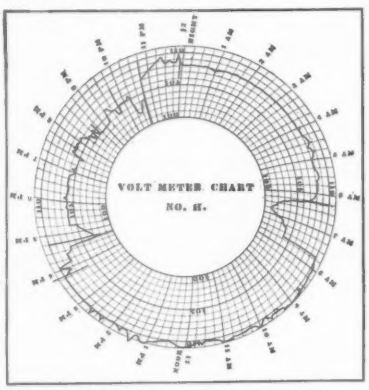


Chart "H" represents the pressure on one of the circuits of a single phase, house to house transformer, alternating system in Chicago.

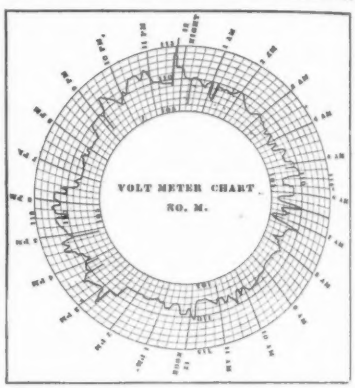


Chart "M" represents the pressure regulation of an alternating-current system on a long avenue, where are used 4 primary feeders with four 15 k. w. transformers, the secondaries in multiple on the three-wire system.

Uniformity of pressure throughout an incandescent electric lighting system is absolutely essential to commercial success. To accomplish this different methods have been proposed at different times. It often happens that the original plan of distribution, laid out by the constructing engineer, does not meet the requirements, after several years' growth of the business, for in all cities lighting business may localize at certain special points, and so demand a remodeling of the existing system of conductors or require some means of correcting for the inequalities of pressure that are due to the unevenly distributed load.

In the Edison systems built prior to 1890, it was customary to introduce in series with each feeder a resistance box with capacity to carry the entire current of the feeder and of resistance much greater than that of the feeder itself. The resistance box is commonly known as a feeder equalizer. From the end of each feeder where it connected with the mains, a set of pressure wires was run back to the station and there connected to pressure indicators. The method of regulating was to designate the feeder supplying the most important district in the system the standard feeder, and to keep its pressure constant, say 110 volts. Each pressure indicator of the other feeders was differentially wound, so as to receive the pressure of the standard feeder as well as the pressure of its own feeder. When there was any difference of pressure between the standard feeder and a given feeder, the latter's indicator needle would deflect to one side or the other according as the pressure on that feeder was higher or lower than the standard, and if the equal of the standard, the indicating needle would stand in the center. If, then, any indicator showed that its feeder was low in pressure, some resistance would be cut out of its feeder equalizer, and, the resistance diminishing, the volts' loss on the feeder would then become less, and thus the feeder could be brought to the same pressure as the standard. If the pressure of the feeder were high, the operation would be the reverse.

With this method of regulation, the entire output of the station must be at such pressure at the station switchboard as will permit the delivery of the correct pressure at the end of that feeder, the product of whose load and resistance is greatest in the system. There are some large stations in America operating to-day on this plan of regulation, notwithstanding that it is an expensive and troublesome one. Another method of regulating, which may be employed where the load is fairly well distributed, is by cutting out the feeders which are high and forcing the current to travel through the remaining feeders and the mains, thus increasing the fall of pressure to the end of the feeders which were formerly high.

The only economical and safe way to regulate in a city where the distances are not abnormally great, and where the load is fairly well distributed, is to so design the conducting system that it will be self-regulating; that is, so that it will require no change of the resistance of feeders or anything of the kind.

A good conducting system should have an ample number of feeders reasonably close together, and the connecting mains should be of generous cross-sectional area.

A valuable adjunct to a station, where there are one or two straggling feeders of great length so located that they can not be interconnected with the general system so that they may be benefited by such connection, is what is known among the Edison companies as the "Booster." The "Booster" is a direct-current dynamo wound for a large current and low voltage, and is used for raising the pressure of the station and of the feeders which are ordinarily low. The "Booster" dynamo should be series wound and so designed that its voltage will be proportional to the current passing through it, the speed remaining constant. It is connected in series with the feeder, whose pressure is to be raised, and is belted to or directly connected with a motor which drives it at the speed for which it is designed. Its action is as follows: The current passing out on the feeder also passes through the field and armature of the "Booster" dynamo, and an electro-motive force is thus added to that already existing on the feeder due to the dynamos of the general system. As the load on the feeder increases, the electro-motive force of the "Booster" dynamo increases proportionately, and adds to that of the feeder, thus overcoming the loss of pressure due to the increased current in the feeder, which enables the feeder to deliver the proper pressure at its mains. The "Booster" may also be employed to raise the pressure of a number of feeders which are connected to an auxiliary bus-bar. In this case, the "Booster" would be connected between the main bus and the auxiliary bus, and would carry all the current of the auxiliary bus, raising the pressure of it as its load increases, and decreasing as the load decreases, as described in the case of the single feeder.

In some central stations two or more potentials or pressures are used, certain dynamos working on a bus-bar at one pressure and the other dynamos working on another bus-bar at different pressures.

This method is only economical when the dynamos can be worked very near the maximum load, which is not often the case. In some cities the dynamos in central stations, or machinery or storage batteries in sub-stations, feed into one general system

at different points, each station or sub station operating at such pressure as will deliver the same voltage at the feeder end of the mains. This is, without doubt, the method to be recommended as giving the best efficiency and assuring reliability of service throughout the system.

With the method proposed in case of accident to any one station, either by fire or lack of water supply, the whole system will not be shut down, but each station will take its share of load which comes from the shutting down of the disabled station.

Municipal legislation in all large cities requires, and very justly so, that the wires for the distribution of electricity for lighting and power purposes should be laid underground. The Edison companies throughout the country use a standard system of underground, the mains and feeders consisting of japanned iron pipe, in which are three solid copper wires or rods insulated from each other and from the iron pipe by an asphaltum compound. These pipes, or "tubes," as they are commonly called, are 20 feet in length, the copper conductors projecting three inches on each end, making the total length of each pipe 20 feet 6 inches.

The copper conductors are connected together by means of a flexible coupling, composed of a stranded copper cable about eight inches in length, and having copper terminals on either end, and which are provided with a circular opening of such diameter as will permit the reception of the copper conductor of the tube. The copper terminal is heated by the flame from a blow lamp, and the copper conductor is soldered into the terminal.

After the three couplings are connected an iron ball clamp is bolted on to the tube near the end, and a cast-iron, oval-shaped coupling box is laid over the copper joint and fastened together by bolts and nuts. The coupling box is then filled with hot insulating compound, and after this has settled by cooling, the box is again filled and the opening covered by plugs.

At each street intersection these tubes enter a junction box. The junction box is a cylindrical cast-iron box in the center of which is a cast-iron upright standard carrying three rings of flat copper bar. To one of these rings all of the positive conductors are connected, to another ring all the negative conductors, and to the remaining ring all of the neutral conductors are connected in a similar manner.

Many of the junction boxes are fed by a feeder direct from the central station, the feeder, when Edison tubes are used, being laid in the same manner as the mains before described. The feeders in a three-wire system consist of three conductors, as in the case of mains, with the exception that one conductor which is used as a neutral has usually one-third the area in cross-section of either of the two other conductors. Feeder tubes are made in various sizes, from 250,000 circular mils up to 3,000,000 circular mils. Each feeder tube also contains three small insulated copper wires, which are connected in each coupling box to the corresponding wires in the next tube, thus making a continuous circuit from the feeder end in the junction box at street intersection back to the station. At the generating station these wires connect with a pair of voltmeters, and at the end of the feeder they are connected through fusible strips to the copper rings in the junction box, thus giving in the station the pressure or difference of potential at the feeder end. By means of the junction boxes the system becomes one grand network of conductors connected in multiple and fed at many points by feeders from the central station, similar to that of a well designed gas or water system in a large city. By means of this network of mains the electrical pressure is equalized throughout the system, and the current is distributed properly among the feeders. Every mechanical and electrical detail of the system is very carefully worked out and absolutely interchangeable, and it is without question, when cables are used for the feeders, the most complete, most easily operated, and most permanent underground system yet devised for the distribution of electricity for large cities using a direct-current system of 500 volts and under. With this system the customers are almost absolutely certain to have continuous service, as they are fed from two points under ordinary conditions, and should the main in their block burn out, it is nearly always possible for the company to feed the customers from one or another junction box. The method of coupling affords a perfect house-to-house system of distribution, and renders the placing of services a very easy and simple matter. The system is very easily laid down, and its maintenance compares favorably with other methods of distribution.

The maintenance of good pressure regulation at the customer's meter is very much more easily effected with an interconnected direct-current distribution, such as has been described, than with the ordinary alternating-current central station system, such as has been exploited in this country.

Owing to the parallel operating of direct-current dynamos and distribution systems, the fluctuations in the pressure, due to change over from one machine to another, so prevalent in the ordinary American alternating-current central station, and so annoying to customers, are eliminated, and a carefully operated direct-current central station should show a pressure chart with an average deviation from the mean of less than one volt.

It is possible, of course, and often the careless practice in direct-current stations, to have bad fluctuations of pressure at the times of change over, and also irregularities at other periods, but there is absolutely no excuse for their existence in a well operated and well planned direct-current system.

The parallel operating of the generators greatly simplifies the maintaining of uniform pressure regulation at the lamps, since when several units are connected to the common bus-bar, the regulation for the entire system may be effected by careful attention to one unit, whereas in alternating-current stations, where the generators do not operate in parallel, it is necessary, in order to even approach the uniformity of pressure regulation which exists in direct-current systems operating in parallel, to regulate the pressure accurately on each unit, which is seldom done in practice. Besides the better regulation possible with parallel operating of the dynamos, a further distinct advantage is derived from the economy effected by proper division of load among the units in the stations, this being particularly marked when the distribution systems are also interconnected. Each unit, irrespective of size, may be usefully and efficiently employed at the period of maximum load, and the amount of idle or uneconomically employed investment is reduced to a minimum.

To illustrate the comparative accuracy of regulation obtainable in an interconnected direct current system, and in the ordinary type of independent circuit alternating-current system, let us refer to the pressure charts shown in the enclosed sheets.

If the engineer designing a system employing alternating current in the distribution expects to obtain first-class pressure regulation, he must follow those lines laid down by the engineers who have developed the modern direct-current distribution system. The distribution system of mains should be interconnected, forming one grand network of conductors, with large transformers, located at points where feeders would terminate if it were a low-tension direct-current system, and to these transformers should be brought the primary feeders from the central station, provided with boosting transformers or induction regulators. Pressure wires from the secondaries of the transformers should be brought back to the station, so that the pressure on the ends of the mains may be known and properly controlled. Such a system will be described to you in detail by Mr. Wagner, and I am sure he will agree with me when I say that the single-phase, house-to house transformer, separate-circuit, alternating-current system, such as has been generally exploited in this country, has nothing to recommend it to the central station manager, either from a purely engineering or financial standpoint, although it has fulfilled its mission as a pioneer in the introduction of electric lighting in scattered districts.

One of the advantages to be derived from the use of direct-current distribution, as distinct from alternating-current distribution, is the employment of storage batteries. They may be adopted for use in various ways, in sub-stations in outlying districts where the load factor of the district is very small, in the central stations themselves to deliver the entire output during period of minimum load, at the centers of distribution for discharging during the peak, as auxiliaries in rotary transformer sub-stations for discharge use at the time of the maximum load in the main central station. In addition to any one of the various ways which the battery may be employed, it always acts as a reserve, guaranteeing the consumer good service, in much the same manner as a bank surplus is a guaranty to the depositors in cases of financial emergency.

Storage batteries when installed in central stations or centers of distribution are usually connected to the main bus and allowed to float on the system taking a charging current from the bus or discharging into the bus according to the load on the system, the generating units being worked at such load as will insure the best efficiency of the entire system.

Batteries are economically valuable in connection with the distribution of direct current in systems whose load curve has an average peak width of not more than two hours, since the investment required for storage batteries to carry the peak having an average width of less than two hours is less than the investment required in steam and electrical machinery to do the same work. The storage battery also has the same value that exists in the case of moving machinery as a reserve in meeting sudden increases of load, provided such increase of load does not continue for a sufficient period to wholly discharge the battery and insufficient time remain for recharging before the ordinary load peak of the system appears at the regularly appointed time. Such a condition is rarely and I might say almost never met with, although in rare instances we may approach this condition.

The steam and electrical machinery is rated by the horse-power or kilowatt, and the duration of the load peak does not influence the value of the investment since the machinery may be operated for the full 24 hours at its maximum capacity. The storage battery, however, is rated by the horse-power hour or kilowatt hour, and the investment is nearly directly proportional to the number of hours during which it discharges the maximum capacity, so that if we required the battery to be prepared to carry the full peak prolonged for seven or eight hours every day, the investment in battery would be enormous as compared with steam and electrical machinery to furnish the same kilowatt hours' output. Illustrative of such contingency, let me refer you to the load diagram marked "D," representing the load in the business district of Chicago, December 20, 1897. This is a very extraordinary curve, illustrating the limitation of the storage battery and the possibility of its being rendered ineffective had the early morning peak extended to the arrival of the regular afternoon peak, without affording sufficient time for recharging the battery.

The storage battery has a very distinct value, which is seldom recognized and employed to its full advantage, when located at the central distributing point of a system with feeders radiating to various points in the net work. The battery may be provided with two or more end cell switches, so arranged that they may

be connected in multiple and feed into the main distributing feeder bus, or they may connect also to one or more auxiliary bus-bars with a different number of cells in series, feeding into each bus, thus providing two or more potentials at the center of distribution. It will be found that, when only one pressure is maintained at the center of distribution during the time of maximum load of a large district, the pressure at the ends of the short feeders will be somewhat higher than the standard and they will be overloaded, and at the end of long feeders the pressure will be lower and the feeders underloaded, although the pressure variations at other times may be negligible. Under such conditions the storage battery becomes exceedingly valuable, for, by arranging it to operate at two or more potentials, the long feeders may be connected during the time of maximum load to the auxiliary bus or buses and additional current forced over them, utilizing their full capacity and maintaining a uniform feeder end pressure by means of an investment in end cells very slight as compared with the investment in additional feeders and mains required to accomplish the same result.

The direct-current distribution system is very much better adapted to electric elevator work than the alternating-current distribution, and, as far as I am able to learn, there has not yet been developed a commercially successful direct-coupled electric elevator capable of running at varying speeds and operated by alternating currents.

The direct-connected electric elevator is a piece of apparatus which is of the greatest value to the central station companies, since it is practically the key to the isolated plant situation, and with its aid we are enabled in a large percentage of instances to show to the owners of large mercantile establishments and buildings a decided saving in the purchasing from the central station company of electricity for lighting, elevator and general power service as compared with the cost of operating an isolated plant, using hydraulic elevators. The immense advantage to the central station companies in being able to supply commercially successful electric elevator service economically, may be realized when we consider that there is connected to the systems of the Edison companies in New York, Boston, Brooklyn and Chicago 15,000 horse-power capacity in direct-connected elevators, representing a gross income of approximately $375,000 annually. At the present time alternating-current distributing systems confine us to the use of continuous running motors belted or geared to the elevator pump or winding equipment; but such an arrangement is not fitted for first-class passenger service and is very uneconomical, and similar equipments using direct-current motors were in use 10 years ago, and have long since become obsolete and have been entirely superseded by the direct-coupled electric elevator which operates for approximately one-half the cost.

The use of low tension constant-potential arc lamps, connected in multiple to the distribution system, has made rapid strides during the past three years, and in New York, Brooklyn, Boston, Chicago, and other cities is fast superseding the use of series arc lamps wherever the low tension mains operate, and the day is not far distant when series arc lamps will be employed only in the outlying districts where there is not sufficient business to warrant the extension of the low tension distribution system. The competition effected by the Welsbach gas burner has done much to develop the constant-potential arc lamp, and it is safe to say that with incandescent lighting alone the central station companies are rendered helpless against the improved gas burners; but a successful competitor has been found in the use of the three and one-half-ampere, direct-current, enclosed arc lamp, and as proof of this we have only to compare the results of the central station companies in the large cities, where these small arc lamps have been employed, with the conditions existing in the small towns, where alternating-current systems of distribution furnish incandescent lighting only. In the latter places the Welshbach light is found to be in general use and is affecting very seriously the earnings of these small central stations owing to the lack of an alternating-current arc lamp, which would answer the purpose of the small ampere arc lamp used in connection with direct-current systems. Although very much has been done within the last year in the development of the large alternating-current arc lamp, it is still far from being in the state of perfection, and can not be said to compare practically or economically with the constant potential direct-current enclosed arc lamp.

The use of motor cycles and electric cabs employing storage batteries is becoming more popular every day and in London and Paris they are used very largely, in Paris an Automobile Club having been formed by people owning motor cycles. The central station companies using direct current will undoubtedly find a profitable outlook for their product as the motor cycle becomes more popular, and by locating charging stations for the motor cycles along the central station mains the use of the motor cycle will become more extended.

When we consider the many practical advantages inherent to the direct-current system of distribution which add so greatly to the commercial success of a central station company, it would seem that the original investment required to establish the plant and system should not be the only question affecting the selection of the system to be adopted.

It is universally conceded by all competent and unprejudiced engineers that the alternating-current system of distribution in a closely settled district, which shall approach in commercial value the direct-current distribution system, shall be one which has for its basis an interconnected system of secondary mains, with transformers of large capacity, and high-pressure feeders from the central station to these transformers and generators in the station operated in parallel, as previously described. Therefore the cost of the distribution network in the case of the alternating-current system will not be less than that of the direct-current network, and the cost of transformers, high-pressure feeders and alternating-current dynamos should be compared with the cost of low tension feeders and low tension dynamos of the same capacity, these forming the only points of comparison. The investment in each case depends merely upon the advantageous location of the central station in each individual city.

I have shown in the early portion of the paper that in a large distribution system such as exists in Chicago, that 75 per cent of the total energy supplied to the system is delivered to the business portion of the city, covering an area of one square mile, the stations supplying this territory being three-fifths of a mile from its electrical center. It is therefore self-evident that since such a large portion of the energy supplied is so nearly adjacent to the desirable location of the central station that a direct-current distribution system should form the basis of the general system of the company.

It seems to the writer that the useful field of operation for alternating-current distribution system is not in large cities, but rather in the scattered suburban residence districts and small towns where commercial lighting, elevator service and general power distribution forms an insignificant portion of the demand, and where the first cost of the direct-current installation would so far exceed that of the alternating current system of distribution with primary mains and large transformers for blocks of lighting as to make the interest charges so great that the property would be rendered unremunerative.

The successful central station company of the future will be, as outlined in my paper read before the Association of Edison Illuminating Companies at its last convention, the one combining intelligently the use of alternating and direct currents, employing direct current in the distribution systems in the thickly settled business and residence districts of a city and alternating current for the distribution systems in the scattered residence districts and surrounding suburbs. The energy will be generated at one or two large condensing stations located where water and fuel may be obtained at the minimum cost and the energy transmitted to the various sub-stations located at the electrical centers of the distribution systems. The choice of low-pressure direct current or high-pressure alternating current for the transmission to the sub-stations will depend upon their relative distance from the generating stations, rotary transformers or other forms of current rectifiers being employed in the sub-stations which supply the direct-current distribution networks when alternating currents are used for the transmission.

TELEPHONE NEWS AND COMMENT.

The Camden Telephone Company, of Elizabeth City, N. C., is now thoroughly organized and is ready to begin the construction of its long-distance lines.

The Southwestern Telegraph and Telephone Company has increased its capital stock from $4,000,000 to $5,000,000. The liabilities of the company are $431,000.

Telephone connection has been established between Aberdeen and Ipswich, S. D. The line will be extended on to Bowolli, Roscoe, Eureka and other towns west of Eureka.

The new telephone line between Lexington and Rockbridge Baths, Va., has been completed, and Lexington now has direct telephone communication with Alone, Rockbridge Baths and Wilson's Sulphur Springs.

The directors of the American Bell Telephone Company have voted to issue $5,000,000 four per cent 10-year debenture bonds, dated July 1, 1898. A portion of the issue will be used to refund $2,000,000 seven per cent bonds falling due August 1, 1898.

It is reported that the telegraph line which is to be built by the Canadian Pacific Railway between Montreal and Vancouver will cost $250,000. The wire to be used will be of copper, 300 pounds to the mile, and will weigh about 450 tons.

At the annual meeting of the stockholders of the Diamond State Telephone Company, of Dover, Del., the following directors were elected: H. A. Richardson, R. R. Kenny, Stephen Slaughter, George W. Emory, Edward L. Jones, Dr. E. S. Anderson, Joseph D. Truxton, D. J. Fooks, Charles W. Cullen, William T. Watson, Dr. G. Layton Grier, John A. Clampitt.

The Vance Electric Company, 136 Liberty street, New York city, are introducing a line of desk and ceiling fan motors for direct and alternating currents of most artistic design and excellent mechanical and electrical efficiency. The direct-current motors are designed for 110 to 220 volts, and the alternating desk motors for 7,200 to 16,000 alternations, 52 to 104 volts. In addition to the desk and bracket types for both currents they have perfected a direct-current ceiling fan, but owing to an unexpectedly large demand for this type the remaining supply is limited.

LACHINE RAPIDS PLANT AND THE COST OF PRODUCING POWER FOR GENERATING ELECTRICITY THEREFROM.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, CHICAGO, JUNE 9, 1898, BY W. M'LEA WALBANK.

In order to allow of a fair comparison with other plants, of the cost of producing power for generating electricity from the Lachine Rapids plant, the writer considers it desirable to give you a brief outline of the hydraulic as well as electrical equipment of our works.

The world-renowned Lachine Rapids, as you are all doubtless aware, is situated on the St. Lawrence River, a short distance from the city of Montreal.

The idea of converting the wasted energies of these turbulent waters and harnessing them for the use and convenience of man was not new. As far back as 1866 a company was formed, whose object was to erect dams and construct large hydraulic works about a mile lower down the river than the site of the present power-house; their object being to induce factories to establish their works at the rapids, for at that date the possibilities of electric transmission had not been demonstrated. The scheme, however, never materialized, and since that date various projects have from time to time been talked of, but never matured.

In the Fall of 1895 the Lachine Rapids Hydraulic and Land Company, Limited, commenced its operations. The directors commenced work only after having fully satisfied themselves upon the difficulties to be encountered and overcome, and carefully studying the question of back water, frazil and anchor ice, and went in with a determination to succeed.

The company was honestly formed, without "ground floors" or "subcellars," with a bona fide capital, on which every share represents one hundred dollars ($100) cash. This, the writer considers, has direct bearing on the cost of producing electricity, because a company handicapped by what is called watered stock, or exorbitant promoter salaries, has to pay interest on money it never had the use of.

Having therefore formed a company on a solid and firm financial basis, the property fronting on the Lachine Rapids, and controlling the water-power privileges, was secured, and operations for the development of the water-power commenced.

The hydraulic plant consists of a main dam and power-house, 1,000 feet long, and a wing dam and guard pier 5,000 feet long, forming a head race or basin with an average depth of 12 feet in low water.

To secure this it was necessary to divert the waters of the St. Lawrence and lay bare the bed of the river for a distance of over a mile, and remove over 400,000 cubic yards of rock.

The main dam, which is constructed of a series of isolated cut-stone piers, with head gates and stop logs, furnishing in all 36 flumes and three waste weirs, at the same time forming foundations for the power-house and turbine sheds.

The total development will, when completed, consist of 72 vertical turbine wheels and 12 generators. The wheels connected in series of six, by gearing, to a horizontal shaft, at the end of which a generator is directly connected. The completed power-house will contain 12 such sets. The whole as shown on the accompanying blue prints.

Of the total installation 48 wheels are already in place, and the power-house, head race, tail race and dams are completed.

Each dynamo house will contain four three-phase General Electric alternators, wound for 4,400 volts at full load, and two direct-current exciters at 120 volts. There will be in the total installation three such dynamo houses, containing in all 12 dynamos and six exciters, each exciter being capable of exciting four machines. Each dynamo house will have its own switchboard, of blue Vermont marble, of the very latest design, so arranged that each circuit may be operated from the switchboard of either power-house. The floors are of slate and the building of solid brick. The current is generated at 4,400 volts, avoiding the use of step-up transformers, is transmitted on iron poles over bare copper wire to the city of Montreal, a distance of about five miles, to the sub-stations, where the pressure will be lowered to 2,300 volts, and by means of sub-station switchboards subdivided into the desired units and distributed partly through underground conduits, and partly by overhead construction, throughout the city of Montreal and its suburbs, where we find a population of over 300,000 people offering a market for light and power.

Of the total equipment one-third is already installed.

The wheels were tested at the Holyoke testing flume on April 16 and 17, 1897, and developed at full gate as follows:

With a speed of 76¼ revolutions, discharging 235.33 cubic feet of water per second and developing 300.84 horse-power, showing an efficiency of 81.32 per cent, which would make the total possible output of our power-house about 16,000 kilowatts.

Perhaps the greatest obstacle to a fair comparison of electric current produced by water-power, as against the same current produced by steam, is the first cost. In the former case, especially if a large water-power is to be developed, the expense of the whole installation, such as dams, head and tail races, etc., has usually been made at the commencement, while perhaps only a fraction of the power thus obtainable is at once used, therefore throwing a very much larger capital cost per unit than with a steam plant, which need only install the power necessary for immediate demand and continue increasing or adding thereto, as the demand therefor offers.

In our own case you will notice it was necessary for us to spend about $1,000,000 in hydraulic development. This $1,000,000 is able to furnish us over 20,000 horse-power, whereas it will be some time before we will be able to convince the public of the advantages to be derived from the use of electricity, which is no easy task, as any one familiar with the subject will bear out.

The 5,000 horse-power, from a commercial point of view, will have, for the present at least, to be charged with all the expense of the hydraulic development of over 20,000 horse-power.

In estimating the cost of producing power from the Lachine Rapids, the writer does not take into consideration the cost of distributing power, for this would be the same in either case, whether the prime mover was a water-wheel or a steam engine. He will therefore confine himself to the cost of developing water power and delivering that power on the bus-bar at the sub-station, exclusive of the generator. He will add the cost of transmission line from the source of power to the sub station in the city, because this is directly attributable to water-power plants, as it would not be necessary in the case of a steam plant, unless it were for transmitting power from a coal mine to a city, or following the practice laid down by the Brooklyn Edison company in locating their power-house at a point convenient for obtaining coal and water at reduced prices, using high-tension transmission and converting by rotary converters at various sub-stations.

There will also be included the step-down transformers to bring the pressure equal to that required for local distribution; namely, in the neighborhood of 2,000 volts.

He will also charge the water-power with the drop or loss in power from the rapids to the sub-station.

The writer therefore considers, in justice to the Lachine Rapids plant, it would be necessary to give, first, the cost per kilowatt per year for the portion of the plant at present installed and connected to generators ready for operation, and, second, what the cost will be per kilowatt per year when the whole water-power development is in operation.

1—The total cost of water rights, dams, hydraulic machinery, power-house, transmission line, step-down transformers, etc., is $957,200.

Power developed, 4,000 kilowatts at the generator. Allowing 10 per cent loss, there will be delivered at the sub-station bus-bar 3,600 kilowatts, which is equivalent to $263.83 per kilowatt, capital cost.

This, at 6 per cent, would be equivalent to..... $15.95 per K.W.

Depreciation of $300,000, which will more than cover the cost of that portion of the plant subject to depreciation, rated at 5 per cent and spread over 3,600 kilowatts, would be equivalent to..... 4.17 per K.W.

Operating expenses, including labor, repairs, insurance, amounts to $10,275 per annum, which, divided into 3,600 kilowatts, is equivalent to..... 2.85 per K.W.

Making a total cost per kilowatt on a twenty-four hour day basis, per year.. $22.97 per K.W.

2—The total cost per kilowatt with the whole water-power plant in operation.

Before giving these figures the writer would like to explain that the figures herewith quoted are reliable for the cost of the completed plant, inasmuch as the same is at present under contract with reputable firms, the Lachine Rapids Hydraulic and Land Company having a limited time in which to order the works completed.

The total capital cost with seventy-two wheels installed will be $1,113,273.

Power developed after deducting all losses will be 13,500 kilowatts at the sub-station bus-bar, equivalent to $82.46 per horse-power capital cost, which, at 6 per cent, represents (per annum)..... $4.95 per K.W.

Depreciation per kilowatt will equal..... $1.68 per K.W.

Operating expenses, including labor, repairs, oil and waste and insurance, if taken upon the same basis as already existing, will amount to $20,453, equivalent to..... $1.51 per K.W.

Making a total for a twenty-four hour run per annum of.. $8.14 per K.W.

It will be noticed that the operating expenses, as well as the depreciation per kilowatt, in the latter case is very much reduced, and it is a remarkable feature how constant our operating expenses are, even at present, being practically the same with full load as with no load.

In connection with these figures it might be stated that coal used in Montreal and vicinity is what is known as Nova Scotian coal, and costs $3.50 per ton for run of mine.

The writer would also draw your attention to the fact that the capital cost cited in each of the foregoing cases includes money paid for real estate, of which the company owns over some 8,000,000 feet, fronting on the rapids, intended at some future date to form the site of a suburban town, and which it is hoped and expected will return the money expended in developing the water-power above referred to.

ADVANCE INFORMATION

Electric Light and Power.

AUGUSTA, ME.—The Marancook Electric Light and Power Company has been incorporated, with Frank Ridlon, president; John A. Hamblin, treasurer; capital stock, $10,000.

LITTLE ROCK, ARK.—The People's Light and Heat Company, of Garland County, has been incorporated, with L. D. Cooper, president; W. H. Perry, J. B. Wood, S. H. Stitt, John G. Lonsdale and C. E. Harrell, directors; capital stock, $25,000.

LAWRENCEBURG, KY.—Geo. W. Dyre, of Princeton, Ky., contemplates the establishment of an electric light plant in Lawrenceburg.

CLOVERPORT, KY.—A company will probably be formed to construct waterworks and erect electric light plant.

ST. FRANCISVILLE, LA.—Charles Weydert and Mr. Smith contemplate the establishment of an electric lighting plant.

ATLANTA, GA.—A. L. Koutz, Clerk County Commissioners, can give information concerning electric light plant for new Fulton County jail.

WILLIAMSBURG, KY.—The Mayor may be addressed concerning construction of electric light plant, etc.

MARTINSBURG, W. VA.—The electric light plant will be improved at a cost of $12,000.

ALGONA, IOWA—F. H. Vesper may give information concerning erection of a $12,000 electric light plant.

SHEFFIELD, ILL.—The Sheffield Electric Light Company has been incorporated by T. Sprague, B. F. Dewey and W. E. Jones; light and power; capital stock, $9,000.

CHICAGO, ILL.—The Vicksburg Electric Light and Power Company has been incorporated; capital stock, $100,000. Incorporators: Percival Steele, David R. Lamente and C. D. Donovan.

NEW CASTLE, WYO.—The City Council has granted a six-years' franchise to C. A. Peterson for an electric light plant.

FRANKFORT, KY.—The Paducah Railway and Electric Light Company has been incorporated; capital stock, $200,000. Incorporators: George C. Thompson, T. J. Flournoy, George C. Wallace and W. F. Paxton.

CROWLEY, LA.—J. E. Barry, Mayor, may give information concerning extension and improvement of electric light plant.

LOUISBURG, N. C.—The Louisburg electric light plant has been purchased by J. P. Winston, who will place same in operation.

COVINGTON, VA.—The Mayor may be addressed concerning erection of an electric light plant.

ATLANTA, GA.—A. L. Koutz, County Clerk, may give information concerning installation of an electric light plant in new jail.

MACON, GA.—The Macon & Indian Spring Electric Street Railway Company contemplates the erection of an electric light plant.

BLOSSBURG, PA.—The electric light plant at this place has been completed, and is now in good running order.

New Telephone and Telegraph Companies.

PRINCETON, MO.—The Missouri & Iowa Telephone Company has been incorporated by J. S. Rogers, H. G. Orton, E. M. Hyde and others; capital stock, $25,000.

LYNNVILLE, TENN.—The American Telephone and Telegraph Company has been granted franchise for telephone system and lines.

PITTSFIELD, ILL.—The Pike County Telephone Company has certified to an increase in capital from $3,500 to $5,000.

DES MOINES, IOWA—Central Telephone Company has been incorporated by H. E. Teachout, H. C. Hansen and J. W. Hill; capital stock, $10,000.

SCOTLAND NECK, N. C.—The Scotland Neck Telephone Company will extend its line to Hobgood.

PRINCETON, MO.—The Winston Telephone Company has been incorporated by H. G. Orton, J. B. Hyde, C. P. Rogers and others; capital stock, $1,000.

HAMLIN, W. VA.—The Hamlin-Huntington Telephone Company has been incorporated by R. R. Wilson, C. W. May, R. Sweetland, J. D. Porter and others, to erect and maintain telephone lines; capital stock, $10,000.

HELENA, MONT.—Billings & Musselshell Telephone Company has been incorporated by Christian Yegen, L. L. Moffett, Geo. Spencer and Geo. W. Hondle; capital stock, $5,000.

DANVILLE, PA.—The Montour and Columbia Telephone Company has been incorporated, to run lines in Columbia and Montour counties; capital stock, $25,000. Directors, James H. McDevitt, C. M. Clement, Sunbury; R. K. Polk, T. C. Angle, E. Carman, C. P. Hancock, Danville; H. E. Murty, J. P. Helfenstein and W. H. Vastine, Shamokin.

CHICAGO, ILL.—The Bushnell Telephone Company has been incorporated; capital, $5,000. Miscellaneous incorporators, Joel Lightner, E. E. Johnson, H. A. Cleveland.

DEER ISLAND, ME.—The Deer Isle Telephone Company is constructing a line from this place to Stonington and to Oceanville.

New Incorporations.

INDIANAPOLIS, IND.—The Ludlow Automatic Fire Alarm Company has been incorporated; capital, $50,000. Directors: John T. Dickson, C. M. Zener, John Wocher, Alfred Burdsal and I. N. Richie.

FINDLAY, OHIO—The Heckert Light Company has been incorporated by Henry W. Seney, Charles K. Friedman, Horton C. Rorick, G. G. Fenneberg and Curtis T. Johnson, to manufacture gas generators, on $10,000 capital.

ALBANY, N. Y.—The Albany Construction Company, with a capital of $3,000, to carry on a general construction business, including the equipment of buildings, railroads, electric lines, power-houses and public works, has been incorporated. The directors are Chas. E. Bibber, of Malden, Mass.; Richard Schermerhorn, of Brooklyn, and J. Sheldon Frost, of this city.

BROOKLYN, N. Y.—The Home Electric Company has been incorporated; capital, $25,000. Directors: Walter S. Pierce, J. W. Thorne, of New York city, and J. H. Mason, of Brooklyn.

CHICAGO, ILL.—Howard Electric Company has been incorporated by Robert Greer, William Greer and James H. Parker, to manufacture electric appliances; capital stock, $25,000.

CLYDE, N. Y.—Clyde Gas and Electric Company has been incorporated by L. L. Moses, G. H. Lang, C. W. Field, Edward Moir and J. M. Moir; capital stock, $40,000.

PHILADELPHIA, PA.—Penn Electrical and Manufacturing Company has been incorporated by David M. Wagoner, Frank C. Hacker, Jesse L. Wagoner, Irwin John A. Wright and W. F. O'Neill; capital stock, $12,000.

LAPORTE, IND.—The Munson Company has been incorporated with capital of $100,000. The directors are Wm. P. Everett, John H. Munson, Wm. A. Roberts, Peter J. Heldt and Leroy A. Stringham.

New Electric Railways.

GENEVA, ILL.—The Geneva Lake, Sycamore & Southern Electric Railway Company has been granted 50-year franchise to construct a line from Geneva Lake, Wis., to Morris, Ill.

PEEKSKILL, N. Y.—The Peekskill Traction Company has been granted franchise by the village trustees for the construction of an electric railway through this place.

KEENE, N. H.—Keene Electric Railway Company has been incorporated by F. H. Whitcomb, E. F. Lane, C. H. Hersey, C. J. Woodward, Edward Gustine, F. C. Faulkner, Daniel R. Cole, Hiram Blake and others.

DELPHOS, OHIO—Lima and Delphos capital are about to unite for the construction of an electric railway between the two places if right of way can be secured. W. P. Rittenhouse, of Toledo, is interested.

ANDERSON, IND.—J. W. Lovett, C. W. Hooven, W. H. Huffman and other Indiana men, and Col. C. A. McNair, of St. Louis, have incorporated the Laporte & Michigan City Electric Railway Company, with $50,000 fully paid-up stock. They will begin at once the construction of an electric railway between these points, taking in a great section of northern Indiana.

LIMA, OHIO—A movement is on foot looking to the building of an electric line to connect this city and Delphos by way of Elida and Gomer, which would make a line about 18 miles long.

WILMINGTON, DEL.—The managers of the Wilmington City Railway Company have decided to build the trolley line between Chester and this city over the route of the Philadelphia & Wilmington Turnpike Company, and a survey will be made at once.

Increase of Capital.

HARTFORD, CT.—Hartford Electric Light Company has increased capital stock from $100,000 to $400,000.

The British Volunteer Electrical Engineers.

The British War Office has made an important change in the regulations for efficiency of the Electrical Engineers' Volunteers. By the regulations originally proposed, recruits were required, in addition to military drills and eight days' training in camp, to attend 78 technical drills. By the modified regulations the 78 technical drills are reduced to 12. While this will make the work of recruits living in London much easier, it will also make it quite practicable for men residing at a distance from London to join the corps; they will obtain their purely military training with any volunteer corps in their own neighborhood, and will complete their technical training by attending in camp two additional days, making, with the eight days' training required from all, a total of 10 days.

The Underground Trolley in New York City.

The New York State Board of Railroad Commissioners granted last week two of the applications recently filed by the Metropolitan Street Railroad Company, of New York city, for authority to use the under trolley system on lines operated by it. The applications granted cover Columbus avenue between 106th and 110th streets, and between Fifty-ninth and Sixty-fifth streets. The commissioners decided that it would be in furtherance of the public interests to grant the applications at once for those portions of the company's lines which are used as connecting links by other lines operated by the under trolley system.

Kindred.... ...Interests

The C. W. Hunt Company, New York city, has issued two new catalogues describing that company's cable railway for handling coal and merchandise, and the Hunt automatic railway.

The Central Electric Company, of Chicago, report a brisk trade on the Westinghouse alternating-current fan motors. One reason for this is undoubtedly the fact that they are carrying large quantities in Chicago stock, and hot orders in hot weather can be filled immediately.

The Thomson Electric Welding Company, of Lynn, Mass., has issued a well illustrated catalogue describing its apparatus for the electric welding of metals. The standard apparatus is manufactured by this company for welding a wide variety of articles. The catalogue may be had free on application.

The American Electric Telephone Company, Chicago, has recently been compelled to enlarge its manufacturing facilities by securing additional floor space and increasing the number of employés. Evidently the high grade of the company's apparatus makes it easy to secure a generous share of the business.

The Central Electric Company, of Chicago, report a number of new specialties in their house goods department, prominent being a new device for electrically lighting the incandescent gas or Welsbach burner. It's a marvelously simple device and will doubtless be appreciated by the trade who have been asking for a device of this character.

The John A. Roebling's Sons Company have issued a novel and handsome advertising hanger, which depicts the forward deck of one of our battle-ships, with the American flag in colors streaming from the military mast. The legend "It Still Waves" occupies a prominent place. This advertising device is one of the most unique and artistic that the ELECTRICAL REVIEW has received for some time.

The Sterling Electric Company, Chicago, has found it necessary to open a southern office, and has appointed Mr. H. A. Coit agent for the Southwest, with headquarters in the Laclede Building, St. Louis. Mr. Coit has been engaged in the telephone business for a number of years, and his long experience makes him exceptionally well fitted for the position. A complete line of samples of the Sterling company's products will be shown in the St. Louis office.

The new power-house now being erected by the Portchester Street Railway Company, of Portchester, N. Y., is a building 45 feet by 84 feet, and consists of a boiler-room, engine and dynamo-room. The building has brick side walls, in which are built steel columns supporting a steel truss roof. In the engine-room is a traveling crane, arranged so that any part of the engines or dynamos on the floor below can be readily lifted and moved from one place to another. The power-house is built in a substantial manner, and is a well designed modern station in every respect. The steel work for this building was designed and is being erected by the Berlin Iron Bridge Company, of East Berlin, Ct.

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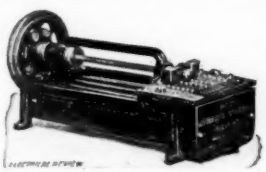

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[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JUNE 14, 1898.

605,478 Automatic stop mechanism for printing presses; G. Gibbs, Milwaukee, Wis.

605,498 Incandescent electric lamp; O. H. Michaelson, Charleston, W. Va.

605,503 Electric railway; A. J. Moxham, Lorain, Ohio.—In an electric railway, the combination of the crossing track rails, the contacts adjacent thereto, and the hand-operating switch in series with said contacts.

605,525, 605,526 System of electrical distribution; C. P. Steinmetz, Schenectady, N. Y.—A dynamo electric machine, having out-of-phase coils connected to three collector rings, and the remaining terminal of one coil connected to an intermediate point on the second coil, and a fourth collector ring likewise connected to the intermediate point in the last-named coil.

605,548 Electric recording instrument; C. L. Jaeger, Maywood, N. J.

605,575 Carbon transmitter; G. W. Goss, Kokomo, Ind.—In a carbon transmitter, the combination of a carbon-holder having a chamber to receive the powdered carbon, and a stirring device disassociated from said carbon-holder and arranged in said chamber to agitate the powdered carbon therein, without affecting the adjustment of the carbon-holder.

605,580 Telephone circuit and apparatus; M. G. Kellogg, Chicago, Ill.

605,592 Letter-box; M. J. Wine, Washington, D. C.—In a letter-box, and in combination with electrical circuits made and broken therefrom, a signal-box, oppositely disposed electro magnets in the signal-box in said circuit, a pivotally supported armature between the poles of the magnets and formed with a sector rack on its free end, a pinion journaled to mesh with the said rack, an arm on the journal of the pinion formed with an inverted cup on its free end, and a lamp in the path of the cup.

605,594 Telephone receiver; P. C. Burns, Chicago, Ill.—In a telephone receiver, the combination with the permanent magnet and its accessories of the insulating disk secured to the heel thereof, the sleeve adapted to slip over said disk, the screw-threaded collar, the adjusting ring, the stop screws, the diaphragm and the diaphragm cap.

605,598 Electric elevator; H. Cochrane, Chicago, Ill.—The combination with the compound electric motor of a brake therefor, a brake-magnet provided with a series and shunt winding, and switching apparatus for cutting the starting resistance into and out of the armature circuit, for cutting the series field coils into and out of the circuit, and for cutting a resistance into and out of the shunt field circuit.

605,615 Ore stamp; D. M. Smyth, Pasadena, Cal.—The combination with the stamp and the electro-magnets for actuating the same, of a switch that is actuated by an upward movement of one stamp to change the circuit connections for raising another stamp.

605,659 Automatic apparatus for telephone switchboards; J. H. West, Berlin, Germany.

605,661 Insulating electrodes for electric gas lighting burners; A. L. Bogart, Jamaica, N. Y.—In an electric igniting device, the combination with one of the electrodes formed of a metal wire or strip, of an insulating shield through which said wire or strip is threaded.

605,663 Electric railway; ?

605,664 Combined train-arresting and signaling mechanism for electric railways; C. H. Davis, New York, N. Y.

606,665 Electric meter; T. Duncan, Fort Wayne, Ind.—An electric meter provided with an annular armature, coils exterior to the armature connected in circuit, a cross shaped magnetic core within the armature, coils on two poles of the core, also connected in circuit and closed circuits on the other poles of the core.

605,670 Telephone switchboard system; F. C. Hughes, Detroit, Mich.

605,688 Selector signaling system; T. C. Drake, Malta, Ohio.

605,695 Secondary battery; C. Brault, Paris, France.—In an electric accumulator, or storage battery, the combination with the body of active material of an enclosing fabric of asbestos, an outer covering or enclosure of perforated neutral material and cross-rods, or bars, lying in openings in the active material, their end being connected to the neutral plates by a solvent of the material of which said plates are composed.

605,714 Electric arc lamp; D. Higman, Boston, Mass.

605,765 Apparatus for supplying or measuring currents of electricity; —The combination of clock-work and their adjuncts, with mechanism for cutting off the current supply and means for simultaneously stopping the clock-work.

605,795 Automatic electric fire-alarm; H. A. Olsson, Quincy, Mass.

605,798 Electric railway signal; C. L. Renrew, East Windsor, Ct.—In a railway signal system, a slide, a trolley carried by said slide, an inverted V-shaped recess in said slide, and a pin projecting into said recess.

605,814 Electric railway system; H. A. Chase, Boston, Mass.—In a conduit system for electric railways, a conduit and parallel guide having branches connected by a bridge, whereby a trolley may run from a main conductor upon a branch conductor.

605,824 Electric railway; R. M. Hunter, Philadelphia, Pa.

605,832 Telephone transmitter; W. E. Sundberg, Worcester, Mass.

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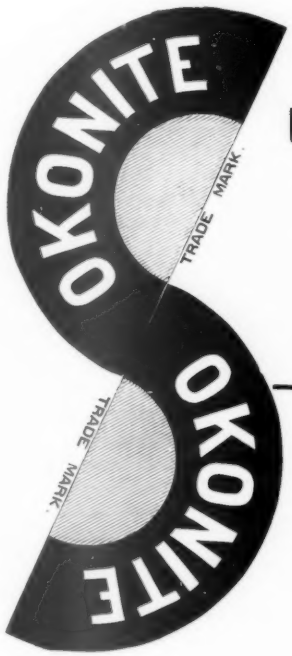

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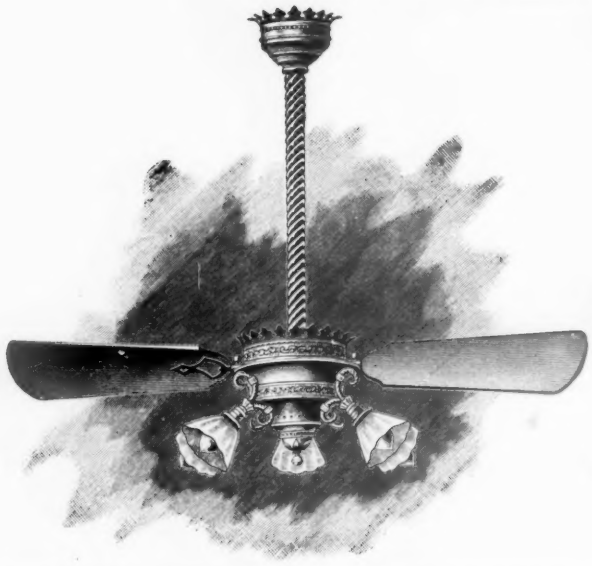

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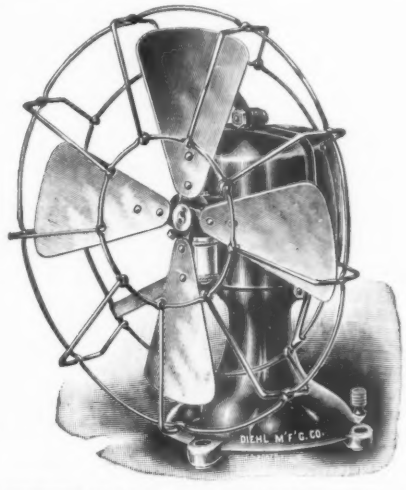

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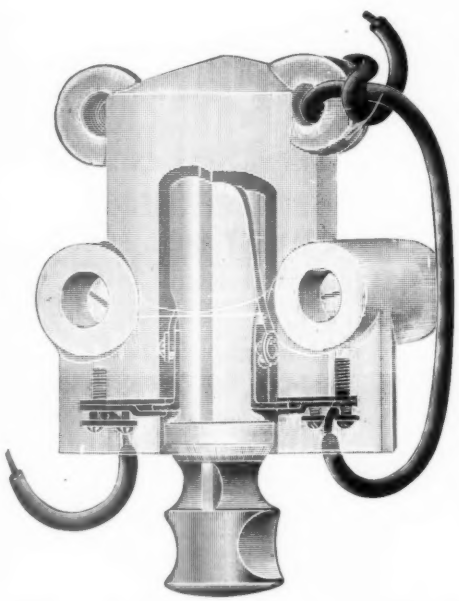

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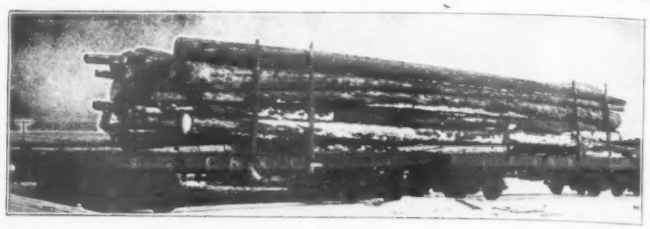

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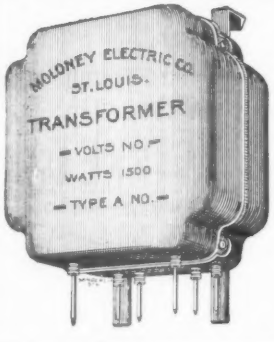

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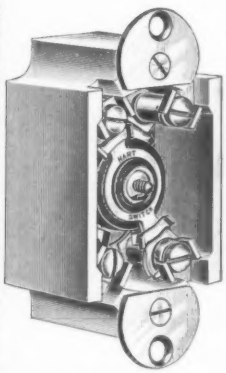

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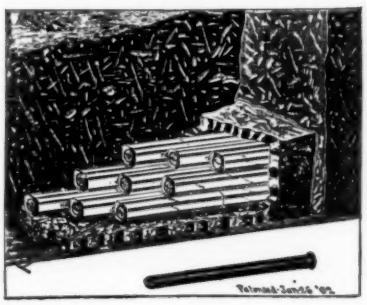

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INDEX OF ADVERTISERS.

PAGE

A

Abendroth & Root Mfg. Co., boilers..... xx
American Bell Telephone Co..... xviii
American Electric Telephone Co., long-distance telephones..... xvi
American Electrical Works, insulated wire. i
American Tool Works Co..... xiv
Armington & Sims Co., engines..... vi
Automatic Switch Co..... 431

B

Babcock & Wilcox Co..... xx
Baker & Co., platinum..... v
Ball & Wood Co., engines..... xv
Barnes Co., The Wallace..... ix
Berlin Iron Bridge Co..... 431
Bibber-White Co..... x
Bogart Co., A. L..... i
Brady, T. H..... 432
Bristol Co..... i
Brown-Bierce Co..... vi
Brush Electric Co.....
Buckeye Electric Co..... xi
Bullock Mfg. Co., M. C..... xv
Bunnell & Co., J. H., dry batteries..... i

C

Camp Co., H. B..... xi
Central Electric Co., electrical supplies..... iii
Central Manufacturing Co..... iv
Chicago Edison Co..... 432
Columbia Incandescent Lamp Co..... i
Crofton Storage Battery Co..... 432
Cross Electrical Co..... iv
Crown Woven Wire Brush Co..... xvii
Cutter Electrical and Mfg. Co., circuit-breakers.....

D

Davis & Ludwig Foundry Co..... iv
De Mary Quick-Break Switch Co..... 431
De Veau & Co..... xvii
Diehl Manufacturing Co..... vii
Dixon, Jos., Crucible Co., belt dressing..... v
Duval, E. S., Jr., patents..... 432

E

Eastern Electric Cable Co..... xx
Eddy Electric Manufacturing Co..... iv
Electric Appliance Company, supplies..... i
Electric Novelty Mfg. & Construction Co..... ix
Electric Storage Battery Co..... iii
Electrical Engineer Institute of Correspondence Instruction..... 431
Empire China Works, porcelain specialties. xviii
Eppinger & Russell Co., Valentine subway electrical conduit..... v

F

Fan Telephone and Construction Co..... xvi
Faraday Carbon Co., carbons..... i
For Sale..... 432
Forest City Electric Works.....
Fort Wayne Electric Corporation..... x
Frink, I. P..... xx

G

Garvin Machine Co..... xiv
Garton-Daniels Electric Co.....
General Electric Co..... vii

H

Hammacher, Schlemmer & Co., spring wires x
Hart & Hegeman, electric switches..... xi
Hawley & Hoops..... 431
Holtzer-Cabot Electric Co.....

I

India Rubber and Gutta Percha Insulating Co..... vi
International Correspondence Schools..... 432

J

Jahl & Co..... iv

K

K. & W. Company..... xi
Keystone Electrical Instrument Co..... xiv
Kirmayer & Oelling..... x
Kline & Co., Wm..... iv
Kokomo Telephone & Electric Co..... xviii

L

Leffel & Co., James..... xx
Lehigh Valley Creosoting Co., creosoted lumber..... xviii
Lombard Water-Wheel Governor Co..... xx
Long Island R. R..... xiii

M

McLennan & Co., K..... xiv
Marietta Manufacturing Co.....
Marshall, Wm., condensers..... vi
Maryland Telephone Mfg. Co..... xviii
Massachusetts Chemical Co..... i
McIntire Co., The C..... x
McKenney & Waterbury..... i
Mianus Electric Co..... xviii
Moloney Electric Co..... x
Monarch Manufacturing Co..... vi
Montauk Multiphase Cable Co..... vi
Munsell, Eugene..... xvii

N

National Carbon Co.....
National India Rubber Co.....
Naugle, Holcomb & Co..... x
New England Engineering Co..... xv
New York & Ohio Co..... i
New York Insulated Wire Co., Grimshaw wires and cables..... i
New York Telephone Co..... i
Newton Appliance Co.....
Novelty Electric Co., supplies..... x

O

Okonite Co., insulated wires and cables... i, vii, xx
Ostrander, W. R., & Co., supplies..... 431

P

Paiste, H. T., Co..... xviii
Partrick, Carter & Wilkins..... iv
Pass & Seymour..... ix
Pennsylvania Electric Co., telephone supplies..... xviii
Perfection Supply Co..... i
Peru Electric Manufacturing Co.....
Phillips Insulated Wire Co., wire..... xiv
Phœnix Carbon Co..... i, v
Phœnix Glass Co.....

R

Reading Electrical Manufacturing Co..... iv
Ritchie & Sons.....
Rochester Electric Motor Co..... iv
Rodrigues, M. R..... xiv
Roebling's Sons Co., John A.....
Rose Polytechnic Institute..... i
Royce & Marean, electrical supplies..... xviii

S

Safety Insulated Wire & Cable Co..... 432
St. Louis Electrical Supply Co..... v
Sawyer-Man Electric Co.....
Schiff, Jordan & Co..... xiv
Schoonmaker, A. O..... xvii
Sipe & Sigler.....
Solar Carbon & Manufacturing Co..... xi
Sprague Electric Co..... ii
Standard Paint Co..... xiv
Standard Telephone & Electric Co..... xviii
Standard Underground Cable Co..... i
Stanley Electric & Manufacturing Co.....
Stephenson Co., Ltd., John..... xx
Sterling Electric Co..... xvii
Sterling Supply & Manufacturing Co..... iv
Stirling Co., water-tube boilers..... xx
Stromberg-Carlson Telephone Mfg. Co..... xvi
Swett & Lewis.....

U

U. S. Desk & File Co..... iv

V

Vance Electric Co..... xiii
Varley Duplex Magnet Co..... 431
Viaduct Mfg. Co., telephones, etc..... ix, 432
Vulcan Foundry Co..... xx

W

Walker Co..... xiii
Wanted.....
Ward Leonard Electric Co..... 431
Warren-Medbery Co..... xv
Washington Carbon Co..... iii
Wells, Heber..... i
Western Electric Co..... v
Western Telephone Construction Co..... xvii
Westinghouse Electric & Mfg. Co..... xix
White & Co., J. G., engineers and contractors 431
Wurdack, Wm..... 432

CLASSIFIED LIST.

Alternators.
Warren-Medbery Co.

Arc Lamps. (See "Lamps.")

Arresters.
Garton-Daniels Electric Co.

Batteries, Primary.
Bunnell & Co., J. H.
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Crofton Storage Battery Co.
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Bunnell & Co., J. H.

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Brady, T. H.

Mica.
Munsell, Eugene.
Schoonmaker, A. O.

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Duvall, Edw. S.

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Western Electric Co.
Western Telephone Construction Co.

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De Mary Quick-Break Switch Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Newton Appliance Co.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Farr Telephone and Construction Co.
De Veau & Co.
Kokomo Telephone & Electric Co.
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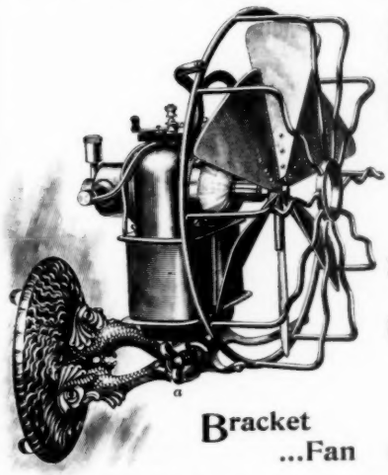

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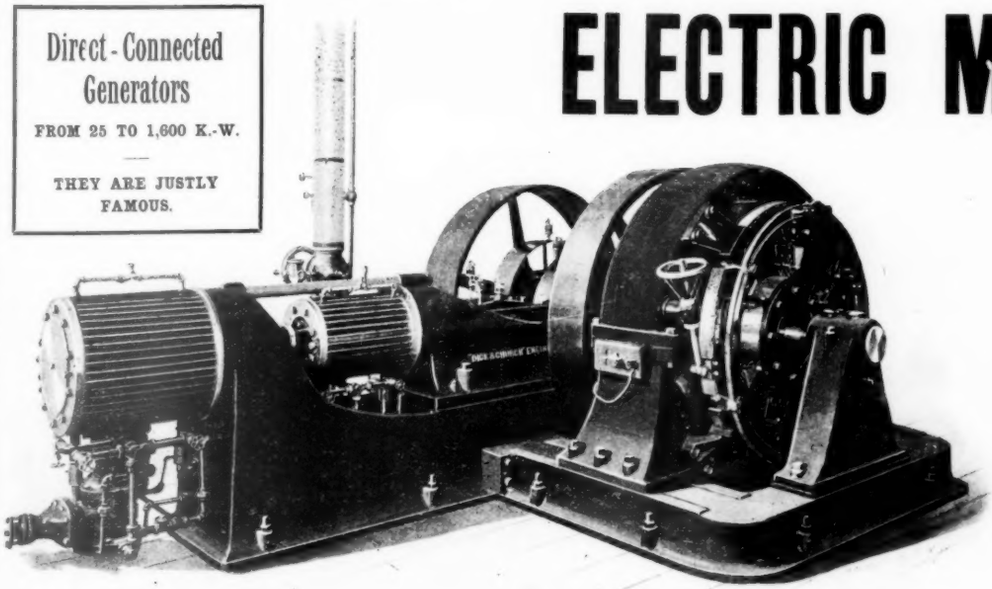

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